THE TRILOBITE FAUNA OF THE CAMERASPIS ZONE IN THE BASAL WILBERNS LIMESTONE OF TEXAS

THESIS

Presented to the Faculty of the Graduate School of
The University of Texas in Partial Fulfillment
of the Requirements

For the Degree of

MASTER OF ARTS

By

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Austin, Texas

February, 1944.

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INTRODUCTION

Purpose and Method of Investigation. This paper presents the results of a paleontologic study of the basal 50 feet of the Wilberns limestone and its contact with the underlying Cap Mountain limestone. Seven trips were made to the Central Mineral Region (Llano Uplift) of Texas between March and November of 1942. Collections were made at 11 localities selected at intervals to complete a circle around the area, the total number of stations in the final collection being 130. The specimens were prepared, numbered, identified, and photographed by the writer. The numerical system used is interpreted as follows: "42" represents the year in which the specimens were collected; "2w", the locality; ".1" the station at the locality, e.g. 42-2w.1. In listing the stations at which a certain species was found the 42- was dropped for the sake of brevity. All the type numbers refer to specimens in the collections of The University of Texas Department of Geology.

Acknowledgments. Foremost mention should be given Dr. William Charles Bell (Lieutenant, United States Army Air Forces) for the supervision of the work. His attention to details of preparation of material and photographic technique was of the greatest benefit. Later, although serving as an instructor in the armed forces of our country, he found time for a large amount of helpful literary criticism.

Dr. Christina Lochman, Dr. E. A. Frederickson, and Dr. Virgil Barnes were consistently helpful in correspondence and conversation, and the writer considers himself fortunate to have had the aid of such authorities in the field of Cambrian stratigraphy and paleontology.

Great appreciation is extended to Dr. H. Gordon Damon, Mrs. W. H. Stroud, Mr. Charles Shepherd, Judge F. L. Hawkins (writer's grandfather), and Mr. J. Burney Wilson (writer's father) for their interest and aid in solving the problem of automobile transportation under difficult wartime conditions.

Collecting Localities.

42-2w, Lion Mountain ---- Section at base of north end of hill about 10 miles northwest of Burnet, west-central Burnet County.
Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated.)
1.---11 feet, red oolitic limestone, Iddingsia alpersensis, Berkeia wichitaensis
2.---15.7 feet, red limestone, Iddingsia alpersensis, Elvinia roemeri.
3.---16.7 feet, red limestone, Iddingsia alpersensis.
4.---21.2 feet, red limestone, Iddingsia alpersensis, Elvinia roemeri.
5.---24.9 feet, red limestone, Iddingsia alpersensis.
6.---28.9 feet, red-brown glauconitic limestone, no fossils.
7.---34.9 feet, white limestone, Elvinia roemeri.
8.---45.9 feet, white limestone, Elvinia roemeri, Cameraspis convexa.
9.---58.9 feet, Eoorthis-Billingsella bed.

42-3w, White Creek ---- 5 miles south of Llano-Round Mountain road, 7½ miles west of the Round Mountain community. Section is in a side draw 1½ miles upstream from the Crownover Ranch hunting cabins on White Creek, northwest Blanco County.

42-3w, (continued)

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated.)

1.---9.0 feet, red limestone, Cameraspis convexa.
2.---19.8 feet, white limestone (float not far out of place), Iddingsia nevadaensis, Elvinia roemeri.
3.---27.0 feet, green glauconitic limestone, Elvinia roemeri, Pterocephalia sanctisabae.
4.---35.4 feet, soft unglauconitic limestone, Modocia wilbernsensis, Elvinia roemeri, Cameraspis convexa, Dokimocephalites extensus, Burnetia urania.
5.---39.0 feet, hard, white, unglauconitic limestone, Modocia wilbernsensis.
6.---43.8 feet, hard, dark gray, silty limestone, no fossils.
7.---46.8 feet, gray silty limestone, echinoderm stems.
8.---49.2 feet, gray-white silty limestone, Elvinia roemeri, Modocia wilbernsensis, Cameraspis convexa, Dokimocephalites extensus, Pterocephalia sanctisabae.
9.---54.8 feet, Eoorthis-Billingsella bed.
10.---3 feet above base of Welge sandstone, red-brown calcareous sandstone, Elvinia roemeri, Cameraspis convexa.
11.---4.5 feet above base of Welge sandstone, Cameraspis convexa.
12.---57.8 feet, Conaspis zone fauna.

42-4w, Packsaddle Mountain ---- Near top of knob on north limb of hill about two miles from the Llano-Round Mountain road in southern Llano County.

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)

1.---2.5 feet above base of Welge sandstone, white sandstone with orange specks, Berkeia wichitaensis?, Iddingsia nevadaensis?, Drumaspis exlocata.
2.---5.5 feet above base of Welge sandstone, bright orange sandstone, no fossils.
3.---7.5 feet above base of Welge sandstone, hard white sandstone, no fossils.
4.---3.0 feet, soft, red, oolitic limestone, no fossils.
5.---14.2 feet, red limestone, no fossils.
6.---26.0 feet, red limestone, Berkeia wichitaensis.
7.---39.0 feet, red-gray limestone, Elvinia roemeri.
8.---45.5 feet, red silty limestone, Irvingella media.
9.---54.0 feet, white shelly limestone, Elvinia roemeri, Berkeia glabellamersa, Modocia wilbernsensis, Cameraspis convexa, Dokimocephalites extensus.

42-4w, (continued)

10.---55.8 feet, pure white limestone, Dokimocephalites extensus, Cameraspis convexa, Elvinia roemeri, Coenaspis sp.
11.---64.0 feet, soft white limestone, Irvingella burnetensis, Ptychopleurites amplooculata.
12.---65.8 feet, Eoorthis-Billingsella bed
13.---66.4 feet, white limestone, Conaspis zone fauna, a bed of "Maustonia"?, Eoorthis-Billingsella.

42-6w, Backbone Ridge ---- Atop ridge just north of railroad crossing of Kingsland-Marble Falls road about two miles east of Kingsland, western Burnet County.
Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)
1.---3.5 feet above base of Welge sandstone, white-orange speckled sandstone, Elvinia roemeri, unidentified trilobites.
2.---33.6 feet, white limestone, no fossils.
3.---36.2 feet, gray silty limestone, no fossils.
4.---44.2 feet, white limestone, Cameraspis convexa, Elvinia roemeri.
5.---47.6 feet, Eoorthis-Billingsella bed.
6.---52.4 feet, gray shelly limestone, Conaspis zone fauna.

42-7w, White Ranch Road --- 3 miles south of Mason on White Ranch road. Section lies along a slope 1750 feet west of road, central Mason County.
Stations: (figures indicate measured feet above the base of Wilberns limestone unless otherwise indicated.)
1.---11.1 feet, ledge of red limestone just above white conglomerate. No fossils.
2.---13.3 feet, red, unglauconitic limestone, Cheilocephalus wichitaensis, Iddingsia alpersensis, Modocia wilbernsensis, Berkeia wichitaensis, Elvinia roemeri.
3.---24.5 feet, gray, glauconitic limestone, no fossils.
4.---33.5 feet, gray, glauconitic limestone with clay nodules, Berkeia wichitaensis, Irvingella media, Elvinia roemeri, Modocia wilbernsensis.
5.---35.8 feet, gray, glauconitic limestone with clay nodules, no fossils.
6.---37.3 feet, gray, glauconitic limestone with clay nodules, Berkeia wichitaensis, unidentified species of Modocia.
7.---38.7 feet, gray, glauconitic limestone with clay nodules, unidentified species of Modocia, Elvinia roemeri, Berkeia glabellamersa, Cameraspis convexa, Burnetia urania.

42-7w, (continued)

8.---40.9 feet, white glauconitic limestone, Modocia wilbernsensis, Elvinia roemeri, Berkeia glabellamersa, Cameraspis convexa.
9.---43.2 feet, pink, gray, limestone, no fossils.
10.---44.9 feet, white limestone, Elvinia roemeri.
11.---46.0 feet, white limestone, Elvinia roemeri, Dokimocephalites extensus, small Billingsella.
12.---50.3 feet, pure gray limestone, Ptychopleurites amplooculata, Irvingella burnetensis.
13.---52.7 feet, Eoorthis-Billingsella bed.

42-8w, Marble Falls-Burnet Highway --- 4 miles north of Marble Falls on Burnet highway. Measured from a small creek bed west of road up a low hill, southern Burnet County.

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)

1.---17.5 feet, gray, unglauconitic limestone, no fossils.
2.---28.0 feet, gray shelly limestone, Elvinia roemeri, Berkeia wichitaensis, Iddingsia nevadaensis.
3.---39.2 feet, white limestone, Modocia wilbernsensis, Elvinia roemeri, Pterocephalis sanctisabae, Dokimocephalites extensus.
4.---41.0 feet, gray, glauconitic limestone, Berkeia glabellamersa, Cameraspis convexa, Dokimocephalites extensus.
5.---47.6 feet, white, shelly, glauconitic limestone, Irvingella burnetensis, Ptychopleurites amplooculata.
6.---49.0 feet, Eoorthis-Billingsella bed.

42-9w, Baldy Mountain ---- Halfway up west side of Baldy Mountain, located on Lake Buchanan estuary formed by junction of North and South Morgan Creeks. The section is located across the estuary from Dad Barnett's fishing camp, which is one mile south of the Morgan Creek road at a point 9½ miles north of its junction with the Llano-Burnet highway, northeastern Burnet County.

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)

1.---1.2 feet above base of Welge sandstone, white sandstone, Elvinia roemeri.
2.---2.2 feet, gray-green glauconitic sandstone, no fossils.
3.---10.6 feet, red-brown soft oolitic limestone, Berkeia wichitaensis.

42-9w, (continued)

4.---11.6 feet, gray-brown oolitic limestone, Elvinia roemeri, Berkeia wichitaensis, Iddingsia alpersensis.
5.---13.6 feet, red oolitic limestone, Elvinia roemeri, Berkeia wichitaensis, Iddingsia alpersensis.
6.---19.8 feet, white oolitic limestone, Elvinia roemeri, Berkeia wichitaensis, Iddingsia alpersensis.
7.---24.4 feet, soft white limestone, Elvinia roemeri, Berkeia wichitaensis, Iddingsia alpersensis.
8.---27.0 feet, white limestone, Berkeia wichitaensis, Xenocheilos minutum.
9.---31.6 feet, white limestone, Berkeia wichitaensis, Irvingella sp., Dunderbergia ? declivita, Elvinia roemeri, Xenocheilos minutum.
10.---32.6 feet, white limestone with yellow spots of silt, Iddingsia nevadaensis, Berkeia wichitaensis, Dunderbergia ? declivita.
11.---32.8 feet, white limestone, Berkeia wichitaensis, Pterocephalia sanctisabae, Iddingsia alpersensis.
12.---37.8 feet, gray-white limestone, Burnetia urania, Cameraspis convexa, Berkeia glabellamersa, Modocia wilbernsensis, Elvinia roemeri.
13.---41.3 feet, gray-white limestone with some glauconite, Elvinia roemeri, Cameraspis convexa, Irvingella sp.
14.---45.3 feet, white limestone with yellow spots of silt, Ptychopleurites amplooculata, Irvingella sp., Elvinia roemeri.
15.---49.8 feet, yellow-white soft limestone, Modocia wilbernsensis, Irvingella burnetensis, Irvingella media.
16.---51.3 feet, Eoorthis-Billingsella bed.

42-10w, Smoothingiron Mountain ---- 17 miles northwest of Llano on Valley Springs road (5 miles past Valley Springs) in the gap between Smoothingiron Mountain and Lone Oak Mountain. Section extends along east side of Lone Oak Mountain to north of road in a pasture at base of hill, northwestern Llano County.

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)

1.---14.7 feet above base of Welge sandstone, orange sandstone. No fossils.
2.---31.5 feet above base of Welge sandstone, white and orange sandstone 4.2 feet thick. No fossils. The great thickness of the Welge sandstone is in part due to faulting which repeats an undetermined amount of section.
3.---21.7 feet above bed mentioned in #2, the top of which is taken as the base of the Wilberns formation, soft red limestone; no fossils.

42-10, (continued)

4.---25.9 feet, red and gray limestone, no fossils.
5.---34.3 feet, gray silty limestone, Cameraspis convexa.
6.---42.7 feet, gray glauconitic limestone, Elvinia roemeri, Berkeia wichitaensis.
7.---44.8 feet, red limestone, Berkeia wichitaensis, Irvingella sp., Dunderbergia ? declivita, Elvinia roemeri.
8.---49.0 feet, white shelly limestone, Ptychopleurites amplooculata, Irvingella burnetensis.
9.---51.7 feet, Eoorthis-Billingsella bed.
10.---53.8 feet, white limestone, Conaspis zone fauna.

42-11w, Hye ---- Section is located in a bluff on north side of Pedernales River one and a half miles due north of Hye on Wierhausen Ranch. Hye is on the Johnson City-Fredericksburg highway, western Blanco County.
Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)
1.---Base of Wilberns limestone; rotten, red, sandy limestone. No fossils.
2.---6 feet, red sandy limestone with seams of calcite, no fossils.
3.---9.7 feet, red limestone with seams of calcite, no fossils.
4.---14.3 feet, red shelly limestone, no fossils.
5.---36.3 feet, pink and dull gray shelly limestone, no fossils.
6.---37.8 feet, gray silty limestone, Elvinia roemeri.
7.---40.5 feet, white crystaline limestone, undetermined species of Modocia, Modocia wilbernsensis, Elvinia roemeri.
8.---42.9 feet, white crystaline limestone, Iddingsia nevadaensis, Cameraspis convexa, Elvinia roemeri, Modocia wilbernsensis.
9.---50.4 feet, gray-white limestone, Cameraspis convexa, Elvinia roemeri.
10.---53.4 feet, Eoorthis-Billingsella bed.
11.---54.4 feet, Eoorthis-Billingsella bed.
12.---55.4 feet, Conaspis zone fauna.
13.---4.0 feet, red shelly limestone, Iddingsia alpersensis, Elvinia roemeri.

42-12w, Threadgill Creek ---- Section lies downstream and around a bend from the county road crossing of Threadgill Creek at Lang's Mill. Lang's Mill may be located by proceeding 10 miles north of Fredericksburg on the Mason highway and turning west at Hilltop Service Station on Doss Road which is followed for 9.1 miles. At bottom of hill at a road junction take north road for three miles to Lang's Mill, southeast Mason County.

42-12w (continued)

Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated. Stations numbered 7-14 were furnished writer by Dr. Virgil Barnes who collected this locality earlier.)

1.---24.8 feet, white crystaline limestone, Berkeia wichitaensis, Iddingsia alpersensis.
2.---26.2 feet, gray crystaline limestone, Berkeia wichitaensis, Iddingsia alpersensis, Irvingella burnetensis, Irvingella media, Xenocheilos minutum, Dunderbergia ? declivita, Elvinia roemeri.
3.---36.1 feet, gray silty limestone, Dokimocephalites extensus, Elvinia roemeri.
4.---38.0 feet, gray shelly limestone, Burnetia urania, Cameraspis convexa.
5.---39.3 feet, white-yellow shelly limestone, Berkeia wichitaensis, Modocia wilbernsensis, Elvinia roemeri, Cameraspis convexa, Pterocephalia sanctisabae, Dokimocephalites extensus, Irvingella sp.
6.---48.0 feet, Eoorthis-Billingsella bed.

7.---5.0 feet, red limestone, Iddingsia alpersensis.
8.---20.0 feet, red limestone, Berkeia wichitaensis.
9.---22.5 feet, red limestone, no fossils.
10.---35.0 feet, gray limestone, Dokimocephalites extensus, Dunderbergia ? declivita.
11.---40.0 feet, gray limestone, Pterocephalia sanctisabae, Modocia wilbernsensis.
12.---42.5 feet, gray limestone, Dokimocephalites extensus, Dokimocephalites curtus, Burnetia urania, Modocia wilbernsensis, Pterocephalia sanctisabae.
13.---43.0 feet, gray limestone, Acrocephalites gouldi, Ptychopleurites amplooculata, Irvingella burnetensis, Irvingella media, Cameraspis convexa, Modocia wilbernsensis.
14.---45.0 feet, gray limestone, Acrocephalites gouldi, Acrocephalites benesulcatus, Ptychopleurites amplooculata, Irvingella media, Irvingella burnetensis.

42-13w, Camp San Saba ---- At ford of San Saba River near Camp San Saba Monument. Welge sandstone is exposed ¼ mile downstream from ford where basal Wilberns limestone crops out. Via the road on south side of river, ford is one and a half miles downstream from Mason-Brady highway crossing of the river 19 miles north of Mason, southern McCulloch County.

42-13w (continued)

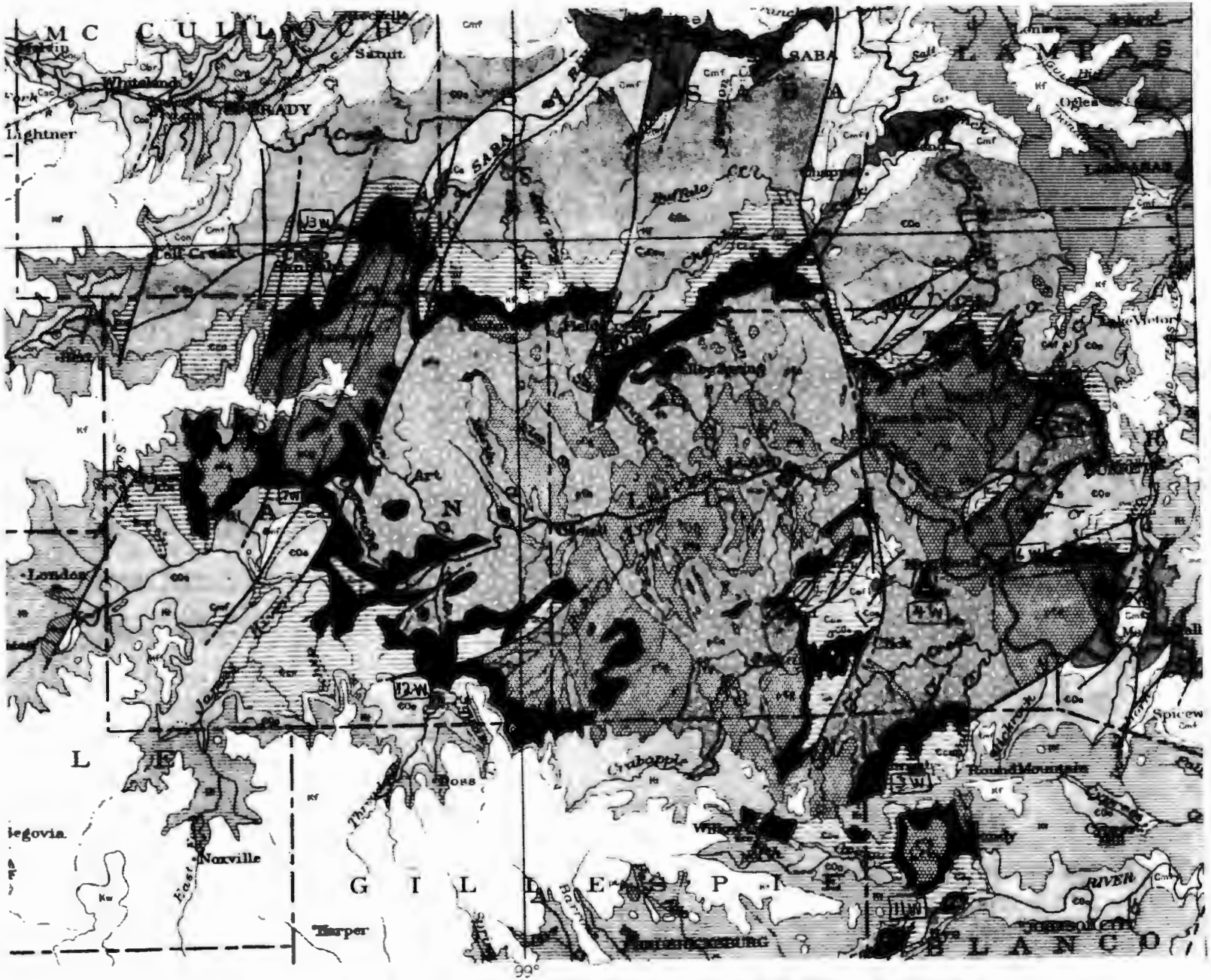
Stations: (figures indicate measured feet above base of Wilberns limestone unless otherwise indicated)

1.---0.8 feet below base of Wilberns limestone; Welge sandstone, limey, orange colored, Iddngsia alpersensis, Elvinia roemeri.
2.---14.1 feet, hard, red-grey limestone, Berkeia wichitaensis.
3.---17.6 feet, hard, grey limestone, Berkeia wichitaensis, Elvinia roemeri.
4.---22.5 feet, hard, grey limestone, Elvinia roemeri.
5.---29.1 feet, hard, grey limestone, Elvinia roemeri.
6.---31.6 feet, white, soft, crystaline limestone, Burnetia urania muta?, Acrocephalites lataegenae, Burnetia urania, Dokimocephalites extensus, Pterocephalia sanctisabae, Cameraspis convexa, Elvinia roemeri, Modocia wilbernsensis.
7.---33.7 feet, white, soft, crystaline limestone, Berkeia wichitaensis?, Pterocephalia sanctisabae, Cameraspis convexa, Elvinia roemeri.
8.---34.4 feet, gray limestone, Elvinia roemeri, Cameraspis convexa.
9.---37.2 feet, red-grey limestone, Dokimocephalites extensus, Cameraspis convexa, Elvinia roemeri, Modocia wilbernsensis.
10.---37.9 feet, Eoorthis, Billingsella-like small brachiopods.
11.---38.6 feet, Elvinia roemeri, Dokimocephalites extensus.
12.---39.0 feet, Eoorthis-Billingsella bed.

STRATIGRAPHY

History of Classification. The formations of Upper Cambrian age exposed in the Central Mineral Region of Texas are, in stratigraphic order: Hickory sandstone, Cap Mountain limestone, Wilberns limestone, and the lowermost portion of the Ellenburger group. Page (1912, pp. 6,7) described the Upper Cap Mountain and basal Wilberns formations as follows:

> Cap Mountain formation: its upper limit, however, is well defined by the top of a glauconitic sandstone which is composed of quartz sand, calcium



LOCALITIES COLLECTED IN THE CENTRAL MINERAL REGION OF TEXAS

> carbonate, and glauconitic grains, ranges in thickness from a few feet to over 50 feet in places. Generally, however, it is from 10-20 feet thick. Above the cross-bedded sandstone the glauconite gradually diminishes in abundance.
>
> The lower portion of the Wilberns ..... is rather thin-bedded flaggy limestone generally mottled by sandy impurities and containing locally a large amount of glauconite.

The glauconitic sandstone at the top of the Cap Mountain formation was named the Lion Mountain sandstone member by Dr. Josiah Bridge (1937a, p. 234). Dr. Christina Lochman (1938, p. 72) has demonstrated that the Cap Mountain limestones contain the basal three trilobite zones of the Upper Cambrian system, those characterized by Cedaria, Crepicephalus, and Aphelaspis. In the same paper she stated that the fossiliferous limestone lenses carrying the Aphelaspis fauna disappear toward the upper limit of the member, and that the uppermost greensands are completely barren of fossils. Concerning the nature of the contact with the overlying Wilberns limestone Dr. Lochman says:

> The upper beds of these greensands pass by the gradual increase of the lime content directly into the limestones of the Wilberns formation. The boundary between the Cap Mountain and the Wilberns, drawn arbitrarily at the first occurrence of the Cameraspis fauna, falls within the transition beds.

The Welge Sandstone. Recent and as yet unpublished work by Dr. Virgil Barnes and Dr. Josiah Bridge in the southern portion of the Llano Uplift has resulted in the recognition

of a basal sandstone member of the Wilberns formation overlying and distinct from the Lion Mountain sandstone at the top of the Cap Mountain beds. This sand has been named the Welge. It is usually quite hard and composed of pure quartz grains cemented with considerable amounts of limonite. In some places the beds are very calcareous. The color of the limey beds is predominately white, but that of the more typical Welge sandstone ranges from reddish brown to bright orange. Glauconite is rare or absent throughout the Welge member. The writer noted, as suggested by Dr. Barnes, that the Welge, which apparently is absent on Lion Mountain and only 2.8 feet thick a mile north on Baldy Mountain, ranges from 5 to 10 feet in thickness in the central and southern portions of the uplift but thickens greatly to the west until it is as much as 25 feet thick at some localities. The following thicknesses were recorded:

Eastern Uplift

Baldy Mountain (42-9w)	3 feet
Lion Mountain (42-2w)	absent?
Marble Falls-Burnet Highway (42-8w)	7 feet
Backbone Ridge (42-6w)	7 feet
Packsaddle Mountain (42-4w)	8½ feet

Southern Uplift

White Creek (42-3w)	6½ feet
Blanco County in general	5-10 feet
Hye (42-11w) (great thickness of sand due to overlap onto nearby granite knob)	25 feet

Cut Off Gap (eastern Gillespie County) . . . . . 8 feet

Western Uplift

Squaw Creek (southern Mason County). . . . . 26½ feet

Threadgill Creek (42-12w). . . . . 27 feet

White Ranch Road (42-7w) . . . . . 10 feet
(base not seen; probably much thicker)

Streeter Road (12.7 miles west of Mason) . . . . . large
unmeasured thickness.

Camp San Saba (42-13w) . . . . . 1 foot
(base not seen; undoubtedly much thicker)

Smoothingiron Mountain (42-10w). . . . . 15-20 feet
(at least this much, possibly even thicker;
section repeated by faulting)

The following four sections are considered representative of the lithology of the Welge. Inasmuch as they each begin in typical Lion Mountain sandstone and end in typical Wilberns limestone, they show also the nature of the contacts of the formations. A gradual change from a sandstone to a limestone lithology is at once obvious. The Lion Mountain-Welge contact is placed at the upper limit of the great mass of glauconitic shale and sandstone and is marked by a color change from green to reddish brown. The contact with the Wilberns limestone is placed at the base of the first bed of red sandy limestone or limey sandstone.

Northeastern Uplift ---- Baldy Mountain (42-9w)

6. Basal Wilberns bed. Red sandy limestone or limey sandstone, oolitic, weathering to soft rotten ledges . . . . . several feet
5. Welge. Gray-green, glauconitic, hard, limey sandstone . . . . . 0.7 feet

4. Welge. Glauconitic soft sandstone and silt . . 1.0 feet
3. Welge. Unglauconitic, white, hard, ferruginous sandstone with a Cameraspis fauna . 1.2 feet
2. Lion Mountain. Soft glauconitic sandstone . . . 5.0 feet
1. Lion Mountain. Glauconitic, hard, cross-bedded sandstone. . . . . 9.0 feet

East-central Uplift ---- Packsaddle Mountain (42-4w)

6. Basal Wilberns bed. Red sandy limestone and limey sandstone, rotten after weathering. . . . several feet
5. Welge. Hard, gray-green, glauconitic sandstone . . . . . 0.5 feet
4. Welge. White, hard, very limey sandstone . . . 0.5 feet
3. Welge. Bright orange, soft, friable sandstone . . . . . 5.0 feet
2. Welge. Orange-white sandstone with a Cameraspis zone fauna . . . . . 2.4 feet
1. Lion Mountain. Green glauconitic sandstone . . unmeasured

Southeastern Uplift ---- White Creek (42-3w)

5. Basal Wilberns bed. Hard, sandy, red limestone . . . . . 4.0 feet
4. Soil covered. Probably shale or soft sandstone . . . . . 3.0 feet
3. Welge. Gray-green, glauconitic, hard, limey sandstone . . . . . 0.7 feet
2. Welge. Orange-white limey sandstone with a Cameraspis fauna at its base. . . . . 3.0 feet
1. Lion Mountain. Green hard sandstone, glauconitic at base . . . . . 3.0 feet

Northwestern Uplift ---- Smoothingiron Mountain (42-10w)

6. Basal Wilberns bed. Red, oolitic, rotten weathering limestone. . . . . several feet
5. Welge. Gray-green hard sandstone . . . . . 0.5 feet
4. Welge. Orange-white limey sandstone. . . . . 4.2 feet
3. Welge. Bright orange, friable, pure, coarse sandstone. Section repeated by faulting. . . . 15-20 feet
2. Lion Mountain. Yellow and green shale. . . . . 6 feet
1. Lion Mountain. Green glauconitic sandstone with linguloid brachiopods. . . . . 1.0 feet

Three types of beds are noticeable in the Welge outcrops; a thin, hard, gray-green, glauconitic, limey sandstone near its top; an orange-white very limey sandstone of varying thickness and stratigraphic position and often bearing a Cameraspis fauna; and a bright orange, soft, friable sandstone, usually of considerable thickness. It is notable that the latter bed occurs only in the western part of the uplift and is unfossiliferous except for rare fragments of linguloid brachiopods. The sudden thickening of the Welge in the western part of the uplift from 8 or 10 to 25 feet apparently is due to the presence of this bed.

All trilobites collected from the Welge sandstone occurred in the orange-white limey sandstone on the eastern side of the uplift. The fauna comprises Elvinia roemeri (Shumard), Iddingsia alpersensis Resser, Drumaspis exlocata Wilson, n. sp., Berkeia wichitaensis Resser, Cameraspis convexa (Whitfield), an undescribed trilobite resembling a form from Wisconsin (Lochman, personal communication dated January 22, 1943), and a single specimen of a protremate brachiopod. Because the Welge fauna is in great part that of the basal part of the Cameraspis zone of the Wilberns limestone and is separated by at least 15 or 20 feet of barren greensands from the Aphelaspis zone of the Cap Mountain limestone, the Welge should be considered as either a member of the former formation or as a separate formation. The Lion Mountain and Welge sandstones together evidently represent

a period of change in marine conditions that reflected itself both in lithology and fauna of the deposited sediments.

The Wilberns Limestone. The basal 60 feet of the Wilberns formation generally comprises thin-bedded limestones. The contact with the Welge is gradational and has already been discussed. Above the ferruginous sands of the Welge are red sandy limestones, frequently oolitic and always soft weathering and brick red in color. Although the sand disappears within a few feet, the red color continues to 25 feet above the base of the formation, a thickness remarkably constant in all sections measured. As the red color fades, the beds become much more fossiliferous and contain glauconite. The limestone is either pinkish grey or more often pure white in color. It is sometimes very crystalline, contains small quantities of siltstone, or is composed solely of trilobite tests replaced by calcite. More detailed information on the stratigraphy of the basal Wilberns is included in the descriptions of collecting localities (page 2 et seq.).

The Cameraspis zone ends at the base of the Eoorthis-Billingsella bed, and the sections were measured from the top of the Welge (base of the sandy red Wilberns limestones) up to this horizon. The interval ranged from 39 feet (Camp San Saba, 42-13w) to 66 feet (Packsaddle Mountain, 42-4w), but in most localities it was a little over 50 feet. The greatest thickness of Wilberns limestone measured by Page (1912, p. 7) was 220 feet, and although the Wilberns varies

greatly in thickness over the Llano Uplift, everywhere the writer studied the formation a complete section of the Cameraspis zone was present at its base.

The fauna collected from the basal Wilberns limestone is typically that of the Cameraspis zone. The species identified are as follows:

Acrocephalites benesulcatus Wilson n. sp.
Acrocephalites gouldi Frederickson
Acrocephalites lataegenae Wilson n. sp.
Berkeia glabellamersa Wilson n. sp.
Berkeia wichitaensis Resser
Burnetia urania (Walcott)
Burnetia urania muta Frederickson
Cameraspis convexa (Whitfield)
Coenaspis sp.
Cheilocephalus wichitaensis Resser
Dokimocephalites extensus (Resser)
Dokimocephalites curtus (Resser)
Drumaspis exlocata Wilson n. sp.
Dunderbergia ? declivita Miller
Elvinia roemeri (Shumard)
Iddingsia alpersensis Resser
Iddingsia nevadaensis Resser
Irvingella media Resser
Irvingella burnetensis Resser
Modocia wilbernsensis Wilson n. sp.
Pterocephalia sanctisabae Roemer
Ptychopleurites amplooculata Frederickson
Xenocheilos minutum Wilson n. sp.

Paleontology. The more common trilobites in the basal Wilberns limestone may be divided into three groups according to stratigraphic position.

Group 1. The Berkeia-Iddingsia Subzone (Welge sandstone and basal 30 feet of the Wilberns limestone--red oolitic and sandy portion--fossils scarce.
Berkeia wichitaensis Resser
Iddingsia alpersensis Resser
Iddingsia nevadaensis Resser

Group 2. The Modocia-Burnetia Subzone (30 to 50 feet above the base of the Wilberns limestone--fossils abundant)
Dunderbergia ? declivita Miller
Dokimocephalites extensus (Resser)
Burnetia urania (Walcott)
Pterocephalia sanctisabae Roemer
Modocia wilbernsensis Wilson n. sp.

Group 3. The Irvingella Subzone (1 to 5 feet below the base of the Eoorthis-Billingsella bed--top of the Cameraspis zone, 1 or 2 feet of very fossiliferous glauconitic limestone.)
Irvingella burnetensis Resser
Irvingella media Resser
Acrocephalites gouldi Frederickson
Acrocephalites benesulcatus Wilson n. sp.
Ptychopleurites amplooculata Frederickson

Elvinia roemeri (Shumard) and Cameraspis convexa (Whitfield) extend from the base of the Welge sandstone through the Irvingella Subzone (Group 3) at the very top of the Cameraspis zone. These two species are not only the longest ranging but also the most abundant in the zone. Although further investigation may show that some of the genera have a more extended range, it is believed on the basis of collections at eleven different localities comprising a total of 130 stations that the indicated stratigraphic position certainly represents a time of maximum abundance for each genus listed, even though some of them may be shown later to transgress the "boundaries" of the subzones. This has already proved to be the case for species of Berkeia and Irvingella.

In connection with these subdivisions of the Cameraspis zone in Texas it is interesting to note Frederickson's

comments on the fauna of the Honey Creek limestone of Oklahoma (1942, MS., p. 23):

> The Cameraspis fauna is characterized by an abundance of Cameraspis and Deadwoodia at the base, followed by species of Elvinia, Dokimocephalites, Acrocephalites, Pterocephalia, Burnetia, and Lingulespsis. Irvingella comes in about the middle of the Cameraspis zone and is very abundant in a thin unit at the top, referred to as the Irvingella zone.

Inasmuch as there is often a great abundance of Cameraspis convexa in the Welge sandstone, and as Frederickson's Deadwoodia species are congeneric with Resser's species of Iddingsia (Frederickson, Personal Communication dated August 30, 1942), the same general subdivisions of the Cameraspis fauna seem to exist in Oklahoma as in Texas.

None of the twenty-three species seems to be geographically restricted, and although neither the Berkeia-Iddingsia nor Irvingella subzone was found at all localities, the writer considers it probable that more extended search will reveal the species in their proper horizons at all localities.

The contact between Cameraspis-bearing strata and those containing an Aphelaspis fauna has been discussed in connection with the Welge sandstone. The top of the Cameraspis zone is marked everywhere over the uplift, as it is in all other mid-continent Upper Cambrian outcrops, by the base of a bed containing Eoorthid brachiopods. In Texas this bed, known as the Eoorthis-Billingsella bed, is

only about 3 feet thick or less, and contains species of both brachiopod genera in great abundance. The bed contains a Conaspis zone trilobite fauna including Conaspis, Orygmaspis, and Stigmacephalus. No Cameraspis zone forms were found at this horizon, and it is probable that no mixing of faunas occurs. At several localities small forms of Billingsella? occur 1 to 5 feet below the true Eoorthis-Billingsella bed, but they are associated with typical Cameraspis zone trilobite genera and are in most cases not so abundant as the larger Eoorthids in the higher bed at the contact between the Cameraspis and Conaspis faunas.

Correlation. The Cameraspis zone has been called by various authors both the Elvinia zone and the Ironton zone. The first name was applied because of the abundance of Elvinia roemeri (Shumard), the second because of the presence of the zone in the Ironton member of the Franconia formation in Wisconsin, where the fauna was first studied. Although the bulk of the fauna described from the Cameraspis zone in Texas constitutes a typical Ironton assemblage, the presence of species of Coenaspis and Acrocephalites indicates that some connection must have existed with the Atlantic trough during this time. The fauna greatly resembles that of the Honey Creek limestone of the Wichita and Arbuckle Mountains, some of the forms being conspecific with those described by Frederickson and Resser from Oklahoma.

The following is a list of formations in the United States known to be Ironton equivalents:

The Atlantic Coast

Ore Hill limestone	Central Pennsylvania
Potsdam sandstone (top)	Lake Champlain Region
Copper Ridge dolomites	Southern Appalachians

Mid-Continent Area

Lower 60 feet of Wilberns limestone	Central Mineral Region, Texas
Honey Creek limestone	Arbuckle and Wichita Mountains, Oklahoma
Basal Davis limestone	Missouri
Ironton member, Franconia sandstone	Wisconsin

Rocky Mountains and Western United States

Basal Snowy Range formation	Montana
A horizon in the Deadwood	Black Hills, South Dakota
A limestone formation	Southwest Sublette County, Wyoming
Gallatin limestone	Teton and Gros Ventre Mountains, Wyoming
Upper Orr formation	House Range, Utah
Dugway Range beds	Utah
Lower Pogonip limestone	White Pine District, Nevada
Secret Canyon shale	Eureka District, Nevada
Rincon limestone, Peppersauce shale	Arizona
A green shale	California

Lochman and Howell (1939, pp. 115-122) correlate the Ironton with parts of the Upper Cambrian section in Novaya Zemlya, Scandinavia, Newfoundland, and New Brunswick on the basis of Acrocephalites and Elvinia, and they indicate a probable correlation with the Olenus zone of the North

Atlantic region. According to them (1939, pp. 120-121) the stratigraphic and faunal break at the base of the Cameraspis zone is world wide, and the Ironton fauna everywhere in North America follows a period of lithologic change.

Geologic History in Texas. The hiatus at the base of the Cameraspis zone, called by Lochman and Howell (1939, pp. 120-121) the most important one in the Upper Cambrian sequence, is plainly reflected in the formations of Texas. Whereas the Hickory sandstone and lower Cap Mountain limestone represent the incursion and gradual deepening of a sea over the eroded Pre-Cambrian surface of the Central Mineral Region, the Lion Mountain glauconitic sandstone probably represents the cessation of marine transgression followed by a period during which the shoreline was stationary, the water shallower, the lands low, and deposition slight. Evidently this environment was unsuited for trilobite existence for the upper Lion Mountain sandstone is barren of all fossils except linguloid brachiopods. Conditions prevailing during the deposition of the Welge and basal Wilberns permitted a reworking and transformation of the glauconite of the Lion Mountain into various oxides of iron. Whether general uplift, changes in current, or some other condition increased the oxygen content of the water is beyond the scope of this paper. In any case the Cameraspis trilobite fauna now appeared; it was utterly different from the Aphelaspis fauna, all the members of which

must have died out during Lion Mountain times. The lithology of the remainder of the Wilberns plainly indicates further deepening and clearing of the water. The sudden incursion of an abundance of Eoorthid brachiopods marked the end of the Cameraspis fauna in the Central Mineral Region as in all other Mid-Continent localities. No lithologic change is evident at the horizon, and the faunal break, though obvious, is not quite complete since Acrocephalites, Irvingella, and Drumaspis are present in higher zones of the Wilberns.

SYSTEMATIC DESCRIPTIONS

Phylum ARTHROPODA

Class CRUSTACEA

Subclass TRILOBITA

Order OPISTHOPARIA

Family KOMASPIDAE Kobayashi

Genus IRVINGELLA Ulrich and Resser 1924

Irvingella burnetensis Resser
Plate 1, figures 1,2

Irvingella burnetensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 20, pl. 3, figs. 28-33.

ORIGINAL DESCRIPTION. The cranidia representing this species are of average size and, as the illustrations show, are rather typical in form. The cranidium is subcylindrical in shape. The dorsal furrow is wide and relatively deep, as are the other furrows. The glabella, convex in both directions, stands completely above the libragenes. In cross section it has a subcircular outline and longitudinally it is curved throughout, but has nearly all of its convexity in the anterior half. The brim is relatively wide and flat, with rather sharply depressed ends. The eyes are long, extending forward almost the full length of the glabella. The fixigenes are about one-third the width of the glabella and their anterior portions are about half their average width.

Cranidium very convex, of moderate size, and with a width of over 10 mm., not quite twice the length. Glabella very large, its front rounded, highly arched transversely over fixed cheeks, longitudinally rising gradually above occipital furrow for some distance, then sloping abruptly

downward anteriorly; glabellar furrows two in number: anterior pair faint, short and straight, posterior pair deep, oblique, and connected across the middle of glabella by a straight deep depression; occipital furrow deep and wide; occipital ring thick, narrowing only slightly at sides. Rim non-tapered, defined by faint marginal furrow, forms a straight bar across anterior end of cranidium; brim absent; fixed cheeks at widest point one-third width of glabella at base, narrow slightly posteriorly, and narrow anteriorly to one half of greatest width, merge with rim on either side of glabella, arch gently, slope laterally downward from glabella and are abruptly bent downward anteriorly; palpebral lobes depressed, long and narrow, extend almost whole length of fixed cheeks, directed posterolaterally from rim to transverse median line at which point they turn to proceed directly posteriorly to a point lateral to occipital furrow, where they terminate; ocular ridges absent; posterolateral limbs very short, straight, hardly distinct from fixed cheeks, traversed by a wide deep furrow.

Facial suture originates at anterolateral corner of cranidium, trends posterolaterally along margin of palpebral lobe to transverse median line, thence passes slightly inward, making a wide curve before turning outward a very short distance along margin of small posterolateral limbs.

Free cheeks and pygidium unknown.

REMARKS AND COMPARISONS. Irvingella burnetensis differs from the small Irvingella media Resser only in having

narrower fixed cheeks and in being considerably more depressed anteriorly. It seems possible that I. media Resser may be merely a juvenile form of the former species, but only more and better specimens and closer study can tell. The abrupt downward curvature of the glabellar front and anterior fixed cheeks is particularly characteristic of I. burnetensis.

OCCURRENCE. Rare in the middle Cameraspis zone, 30 to 45 feet above the base of the Wilberns limestone. Extremely abundant in the Irvingella zone, 1 to 5 feet below the top of the Cameraspis zone where it is associated with Irvingella media Resser, Ptychopleurites amplooculata Frederickson, Acrocephalites gouldi Frederickson, and A. benesulcatus Wilson, n. sp. Stations 4w.11, Packsaddle Mountain; 7w.12 White Ranch Road; 8w.5, Marble Falls-Burnet Highway; 9w.9?, 9w.13?, 9w.14?, 9w.15, Baldy Mountain; 10w.7?, 10w.8, 10w.9?, Smoothingiron Mountain; 12w.2, 12w.13, 12w.14, Threadgill Creek.

HYPOTYPES LPT-1 and LPT-2, Sta. 4w.11, Packsaddle Mountain.

Irvingella media Resser
Plate 1, figures 3-7

Irvingella media RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 22, pl. 3, figs. 46-54.

ORIGINAL DESCRIPTION. This relatively small, abundant species is wider than the other Texas species and in this respect finds closer relatives in the Canadian Rockies.

> The glabella is long, narrow, and considerably constricted toward the front. The occipital furrow and rear glabellar furrows are wide and fairly deep, while the anterior pairs have normal development. Viewed vertically, this species seems to be very broad and flat. From the front it is broad even though the glabella is highly arched. Longitudinally, however, as the side view shows, this species is strongly convex. The brim is rather wide and has a somewhat thickened edge and a shallow anterior furrow. The fixigenes at their widest are about half the width of the glabella at the same point. Their rear moiety is nearly rectangular in shape, but the anterior portion decreases rapidly in width, being reduced finally to the width of the brim. The eyes are long, extending from the occipital furrow to a point beyond the anterior angle of the dorsal furrow. They first curve outward from their rear end for about a third of their length, then bend at a rather sharp angle toward the glabella.

Cranidium small and convex with a width of about 6 mm. and a length less than two-thirds width. Glabella large, tapered anteriorly, highly arched transversely over fixed cheeks, longitudinally rising slightly above occipital furrow for some distance, then sloping abruptly downward anteriorly; circumglabellar furrow wide and deep; glabellar furrows two in number: anterior pair faint, short and straight, posterior pair deep, oblique, and connected across middle of glabella by a straight, deep depression; occipital furrow deep and wide; occipital ring thick, narrowing only slightly at sides. Rim thin, non-tapered, defined by a faint marginal furrow, and forms a straight bar across anterior end of cranidium; brim absent; fixed cheeks at widest point half width of glabella at its base, narrow slightly posteriorly, narrow anteriorly to one-third of greatest width,

merge with rim on either side of glabella, arch gently, and slope laterally downward from glabella; palpebral lobes very long and narrow, depressed, separated from fixed cheeks by distinct furrows, extend from point just in front of lateral extremity of anteriormost glabellar furrow almost to occipital furrow, trend posterolaterally for anterior two-thirds of this length, then proceed straight back, widen gradually posteriorly; ocular ridges absent; posterolateral limbs very short, straight, hardly distinct from fixed cheeks, and traversed by a wide deep furrow.

Facial suture originates at anterolateral corner of cranidium, trends posterolaterally along margin of palpebral lobe to transverse median line, thence passes slightly inward, making a wide curve before turning outward a very short distance along margin of small posterolateral limbs.

Free cheeks unknown.

Pygidium approaches a semicircle in outline, although its posterior margin is straight enough to give it a spade-like appearance; axis occupies about two-fifths total width of pygidium and three-fifths total length, stands extremely high and possesses two large rings and a terminal segment; pleural lobes and segments absent, the smooth border possessing a well defined and thickened rim that in some specimens is flat-lying, but in others rises at anterolateral corners to give it an undulating appearance. A pygidial mould (plate 1, figure 3) leaves the

impression that the anterolateral corner is prolonged into an anteriorly directed spine; other material in the collection fails to substantiate this, however.

REMARKS AND COMPARISONS. Irvingella media is a small species associated with the larger I. burnetensis Resser, from which it differs principally in having wider fixed cheeks. As noted elsewhere it is possible that I. media is merely a juvenile form of the latter species. Of the eight species described by Resser (1942, pp. 17, 20-23) from the Wilberns limestone, only the two just mentioned have been identified in my collections.

OCCURRENCE. Rarely present in the middle Cameraspis zone, 30 to 45 feet above the base of the Wilberns limestone; abundant in the Irvingella zone, 1 to 5 feet below the top of the Cameraspis zone, where it is associated with Irvingella burnetensis Resser, Ptychopleurites amplooculata Frederickson, Acrocephalites gouldi Frederickson, and A. benesulcatus Wilson, n. sp. Stations 4w.8, Packsaddle Mountain; 7w.4, White Ranch Road; 9w.15, Baldy Mountain; 12w.2, 12w.13, 12w.14, Threadgill Creek.

HYPOTYPES. LPT-4 (cranidium), LPT-5 (cranidium), LPT-6 (pygidium), Sta. 12w.13; LPT-3 (pygidium mould), Sta. 12w.14, Threadgill Creek.

Genus DRUMASPIS Resser 1924

Drumaspis exlocata Wilson n. sp.
Plate 1, figure 8

Cranidium moderate in size, being 13.5 mm. wide and 8 mm. long, highly convex longitudinally, less so transversely. Glabella large, tapered anteriorly to half its basal width, its short frontal margin straight, anterior corners rounded, decidedly arched transversely, greatly depressed anteriorly; circumglabellar furrow exceptionally wide and deep, shallowing somewhat anteriorly; three pairs of glabellar furrows: anterior pair practically invisible, middle pair short, almost straight, very narrow, and posterior pair longer, decidedly curved backward, narrow but deeply incised; occipital furrow as wide as circumglabellar furrow, curves inward toward center, of equal width throughout course; occipital ring thick, arched slightly backward, untapered, and as high as dorsal surface of glabella. Rim unknown; brim probably narrow in front of glabella, twice this width laterally and steeply depressed to continue and increase considerably the convexity of the cranidium; fixed cheeks one-third width of glabella, highly elevated, expanded and flattened at palpebral lobes, but greatly depressed longitudinally in both directions; palpebral lobes crescent-shaped, extend from point lateral to extremity of middle glabellar furrow to point halfway between extremities of posterior glabellar and occipital furrows; true ocular ridges absent,

but a slight depression separates the elevated fixed cheeks from the brim; posterolateral limbs depressed, short, narrow, and traversed by a broad deep furrow which shallows laterally and joins circumglabellar furrow posterior to extremity of occipital furrow.

Facial suture unknown at anterior margin, proceeds only slightly inward from extended anterolateral corners of cranidium, circles palpebral lobe, and proceeds posterolaterally at a 45° angle with longitudinal axis.

Surface of cranidium completely and evenly granulated; largest granules on the glabella.

Free cheek and pygidium unknown.

REMARKS. Drumaspis exlocata is founded on one specimen from the Welge sandstone. It differs from D. texana Resser (1942, p. 32, pl. 5, figs. 27-30) in being over twice as large and possessing a laterally expanded brim. In addition it is present in a different subzone and in a different lithology from other Drumaspis species, all of which Resser has described from "middle Franconia zones."

OCCURRENCE. One specimen found 2.5 feet above the base of the Welge sandstone and 6.5 feet below the base of the Wilberns limestone where it is associated with Elvinia roemeri?, an unidentified trilobite resembling Proidahoia Raasch MS, and a protremate brachiopod. Station 4w.1, Packsaddle Mountain.

HOLOTYPE LPT-7, Sta. 4w.1, Packsaddle Mountain.

Family BURNETIDAE Resser

Genus BURNETIA Walcott 1924

Burnetia urania (Walcott)
Plate 1 figures 9-12

Ptychoparia (?) urania WALCOTT, 1890, Proc. U. S. Nat. Mus., p. 274, pl. 21, figs. 10, 11.

Burnetia urania WALCOTT, 1924, Smithsonian Misc. Coll., vol 75, no. 2, p. 54, pl. 10.

Burnetia urania WALCOTT, 1925, Smithsonian Misc. Coll., vol. 75, no. 3, p. 77, pl. 17, figs. 1-3.

Burnetia urania Walcott, FREDERICKSON, 1942 MS., Thesis, University of Wisconsin, Cambrian Stratigraphy of Oklahoma, pp. 71, 72, pl. 2, figs. 1, 2.

ORIGINAL DESCRIPTION. Glabella tumid, truncate-conical in outline; surface marked by two pairs of furrows; the posterior pair extend obliquely backward so as to mark off a triangular lobe on each side. Anterior pair shorter and more transverse in their direction; occipital furrow rounded; occipital ring narrow; dorsal furrow strongly defined. Fixed cheeks narrow, posterior extension unknown; anteriorly they merge into the very short frontal limb; palpebral lobes of medium size and separated from cheek by a strong furrow; a short oblique ridge crosses the dorsal furrow; frontal limb shown only at sides, as the glabella arches down to the groove marking off the broad companulate frontal rim; the latter extends forward to a blunt point and is nearly one-third the entire length of the head. The associated free cheek has a broad margin and a relatively small trapezoidal body beneath the base of the eye lobe.

Surface of the glabella, fixed cheeks, and body of free cheeks strongly pustulose; frontal and side margin smooth.

SUPPLEMENTARY DESCRIPTION. Cranidium either large or moderate in size, highly convex, about as long as wide. Glabella large and prominent, bulbous, its greatest height being near its slightly tapered anterior end; circumglabellar furrow deep and wide; two pairs of glabellar furrows present: anterior pair faint, short, and oblique, posterior pair long, deep, and curved strongly backward medially; occipital furrow very wide and deep throughout its course; occipital ring straight and laterally untapered. Rim concave or flat, width equal to half length of glabella, the courses of its anterior margin and distinct marginal furrow giving it the shape of a wide crescent; brim reduced to a narrow band across preglabellar area, but widens laterally where it slopes up almost vertically to join the fixed cheeks; fixed cheeks extremely convex longitudinally, slope upward transversely from circumglabella furrow so that palpebral lobes are only slightly lower than dorsal surface of glabella; palpebral lobes small, elevated and located slightly posterior to transverse median line of cranidium; ocular ridges very faint and oblique; posterolateral limbs unknown.

Facial suture probably intramarginal to center, trends outward to anterolateral corner of cranidium from which it curves inward to palpebral lobe; further course unknown.

Cranidium strongly pustulose except on rim.

Pygidium unknown, although it is possible that the one assigned to Dokimocephalites extensus (Resser) (plate 1, fig. 19) is really that of Burnetia urania.

REMARKS. Because of their fragmentary nature the specimens of Burnetia urania in the writer's collection contribute nothing new regarding the posterolateral limbs, but Frederickson (1942, MS, p. 72) has described them in his variety Burnetia urania muta.

OCCURRENCE. Seemingly restricted to the middle portion of the Cameraspis zone from 30 to 45 feet above the base of the Wilberns limestone; associated with Dokimocephalites extensus (Resser) and Modocia wilbernsensis Wilson, n. sp. Stations 3w.4, White Creek; 7w.7, White Ranch Road; 9w.12, Baldy Mountain; 12w.4 and 12w.12, Threadgill Creek; 13w.6, Camp San Saba.

HYPOTYPES LPT-8, Sta. 9w.12, Baldy Mountain; LPT-9, Sta. 3w.4, White Creek.

Burnetia urania muta Frederickson MS
Plate 1, figure 13

Burnetia urania muta FREDERICKSON, 1942, MS., Thesis, University of Wisconsin, The Cambrian Stratigraphy of Oklahoma, p. 72, pl. 2, figs. 3-5.

ORIGINAL DESCRIPTION. Cranidium similar in all respects to B. urania (Walcott), but convexity of anterior portion of glabella much reduced so that glabella descends in gradual curve to dorsal furrow instead of appearing to overhand dorsal furrow as in B. urania (Walcott). Posterolateral limb well

developed, extending laterally on line with occipital ring; intramarginal furrow deep and broad. Free cheek, thorax, and pygidium not known.

REMARKS. The Texas specimen consists of the mould of a fragmentary cranidium and adds nothing to Frederickson's description. The rim width is great, being two-thirds the length of the glabella. The glabella somewhat resembles that of Dokimocephalites extensus (Resser), but the rim is that of a Burnetia.

OCCURRENCE. Middle part of Cameraspis zone 31½ feet above the base of the Wilberns limestone. Station 13w.6, Camp San Saba.

HYPOTYPE LPT-10, Sta. 13w.6, Camp San Saba.

Genus DOKIMOCEPHALITES Frederickson 1942 MS.

Dokimocephalites extensus (Resser)
Plate 1, figures 14-20

Burnetia extensa RESSER, 1942, Smithsonian Misc. Coll., vol 103, no. 5, p. 81, pl. 17, figs. 15-22.

ORIGINAL DESCRIPTION OF CEPHALON. The glabella, rounded in front, has two pairs of furrows. The occipital furrow is almost interrupted at the center, and the neck ring carries a large spine. The brim, which comes to a rather sharp point, exceeds the length of the glabella exclusive of the neck ring. A narrow preglabellar area is present. Eyes are strongly bowed and have heavy eye bands. The libragenes illustrated show that the wide doublure apparently extends all the way across, with an increase in width toward the middle.

Cranidium large, averaging about 20 mm. for both dimensions, slightly longer than wide, of moderate convexity.

Glabella slightly longer than wide, prominent, greatly elevated above circumglabellar furrow, somewhat tapered, rounded, and depressed anteriorly; circumglabellar furrow very deep laterally, becoming shallow in front although still well incised at the anterolateral corners of glabella; three pairs of glabellar furrows present: anterior pair barely visible, but posterior pairs wide, deep, long, and strongly oblique; occipital furrow exceedingly strong at sides, shallow at center; occipital ring arched forward laterally and extended at center into a long spine that rises above horizontal at an angle of about 30°, and whose length is about equal to that of the glabella. Rim concave, its posterior portion continuing the downward slope of the anterior part of glabella and preglabellar area, length about equal to that of glabella, its greatest width along shallow marginal furrow, gradually narrowing anteriorly, the frontal margin absent on all specimens available; brim reduced to a narrow band in front of glabella, widens and is greatly depressed laterally; fixed cheeks one-third width of glabella, depressed longitudinally in both directions, but in transverse profile rise gradually from circumglabellar furrow and become horizontal near their lateral edges; palpebral lobes small and crescent-shaped, about half as wide as fixed cheeks along transverse median line, separated from inner fixed cheeks by a distinct furrow, and extended from a point just anterior to lateral termination of posteriormost pair of glabellar

furrows to a point lateral to the occipital furrow; ocular ridge fairly distinct and very oblique; posterolateral limbs narrow, strap-like, extended at right angles to longitudinal axis, moderately depressed, and deeply furrowed.

Facial suture missing at its anterior extremity on specimens available, but Frederickson (1942 MS., p. 75), in describing what is probably this species as Dokimocephalites expansus Frederickson MS., writes that it "cuts the anterior margin on line with dorsal furrow"; proceeds posteriorly along anterolateral margin of the rim, curves evenly outward just before reaching the lateral extremity of the marginal furrow, passes onward from this point to anterior end of palpebral lobe around which it circles before extending abruptly outward along posterolateral limb.

Free cheeks unknown.

Pygidium of moderate size, semi-ellipsoidal in general outline; lateral third of anterior pleural margin deflected posterolaterally at 45° angle with horizontal; anterolateral corners rounded, posterolateral corners sharp where deflected portion of anterior margin joins wide arc of posterior margin. Axis stands well above pleural lobes, extends two-thirds length of pygidium, and possesses three rings and a terminal segment; pleural lobes wide, slope gently down to border, traversed by two segments with secondary furrows that form four ridges on each lobe parallel to course of anterior margin; pleural brim moderately wide,

unsegmented, and bordered by a narrow but elevated rim that seemingly thickens anteriorly.

Cranidium strongly pustulose except on rim; pygidium pustulose on its axial rings.

REMARKS. Although Resser (1942, pp. 70-84) did not distinguish between his "linguloid" forms of Burnetia and the more representative species of that genus, Frederickson (1942; MS., p. 73) created a new genus, Dokimocephalites, from his study of such forms in Oklahoma. He named two species: D. spatiosus (genotype) and D. expansus. No specimens of Oklahoma species were available to the writer, but it was at once obvious from the material collected in Texas that the Dokimocephalites forms differed greatly from the genotype of Burnetia, B. urania (Walcott). Not only is the rim far more extended longitudinally in those species identified by the writer as Dokimocephalites, but the glabella is not so elevated in transverse profile, is longer and more deeply furrowed, and the occipital furrow is much shallower at the center than in Burnetia urania. All of Resser's figured species having the characteristics of Dokimocephalites possess an occipital spine, whereas one is not present in Burnetia urania nor in any of his species closely resembling it. Of the ten species of Burnetia described by Resser, four, B. intermedia, B. extensa, B. curta, and B. lingula seem definitely to belong to the new genus Dokimocephalites. The Texas specimens fit well the

description and figures of Burnetia extensa, an abundant species in the Honey Creek limestone of Oklahoma.

A well preserved pygidium (pl. 1, fig. 19) was associated with single cranidia of Cameraspis convexa (Whitfield) and Modocia wilbernsensis Wilson n. sp., and with three cranidia each of Elvinia roemeri (Shumard), Dokimocephalites extensus (Resser), and Burnetia urania (Walcott). Because of size and lack of surface granulation all but the last two species may be eliminated. The pygidium was assigned to D. extensus rather than to Burnetia urania because the former species is the more common in the Cameraspis zone, and because at another locality a fragment of a similar pygidium was found associated with several cranidia of D. extensus. Resser (1942, p. 81, pl. 17, fig. 22) mentions and figures another and different type of pygidium associated with cranidia of this species.

OCCURRENCE. Moderately abundant in the middle portion of the Cameraspis zone of the basal Wilberns limestone, first appearing about 30 feet above the base of the formation and seeming absent in the Irvingella zone. It is associated with Modocia wilbernsensis Wilson n. sp., Elvinia roemeri (Shumard), Cameraspis convexa (Whitfield), Pterocephalia sanctisabae Roemer, Dunderbergia ? declivita Miller, and Burnetia urania (Walcott). Stations 3w.4, 3w.8, White Creek; 4w.9, 4w.10, Packsaddle Mountain; 7w.11, White Ranch Road; 8w.3, 8w.4, Marble Falls-Burnet Highway; 12w.3,

12w.5, 12w.10, 12w.12, Threadgill Creek; 13w.6, 13w.9, 13w.11, Camp San Saba.

HYPOTYPES. LPT-11 and LPT-14, Sta. 12w.5, Threadgill Creek; LPT-13 and LPT-16, Sta. 8w.3, Marble Falls-Burnet Highway; LPT-12, Sta. 7w.7, White Ranch Road; LPT-15 (pygidium), Sta. 3w.4, White Creek.

Dokimocephalites curtus (Resser)
Plate 1, figure 26

Burnetia curta RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 83, pl. 17, figs. 28, 29.

> ORIGINAL DESCRIPTION. A cranidium has a peculiar large glabella with nearly circular front outline. Three pairs of furrows are visible. Fixigenes and eyes are normal. The brim width is not much more than half the glabellar length and has a normal preglabellar area. The neck ring extends into a long elevated spine that nearly equals the length of the cranidium. Convexity not great in cross section but longitudinally it is considerably more.

Dokimocephalites curtus differs from D. extensus (Resser) only in the shape of the rim, whose length equals that of the glabella and whose anterior margin describes a perfect semicircle. The occipital spine appears to have been unusually large. Although the rim of D. curtus resembles that of Burnetia, the low, deeply furrowed glabella, large occipital spine, and a centrally faint, but laterally deep occipital furrow easily distinguish it from members of that genus.

OCCURRENCE. One specimen from the middle portion of the Cameraspis zone, 42½ feet above the base of the Wilberns limestone and just below the base of the Irvingella subzone. It is associated with Burnetia urania muta Frederickson MS. and Dokimocephalites extensus (Resser). Station 12w.12, Threadgill Creek.

HYPOTYPE LPT-63, Sta. 12w.12, Threadgill Creek.

Genus BERKEIA Resser 1937

Berkeia wichitaensis Resser
Plate 1, figures 21-25

Berkeia wichitaensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 92, pl. 15, figs. 31-33.

ORIGINAL DESCRIPTION.

> The rather long cranidium has the usual long glabella in which two pairs of furrows are well defined. The fixigenes average less than a third of the glabellar width. The preglabellar area is wider than the rim. In this species the rim expands somewhat to the middle, which together with the more angular anterior margin exaggerates the actual length of the cranidium.

SUPPLEMENTARY DESCRIPTION. Cranidium convex, rather small, slightly wider than long. Glabella prominent, longer than wide, tapered anteriorly to almost half its width at base; circumglabellar furrow extremely wide and deep, giving the glabella a sunken appearance; three pairs of glabellar furrows present, but the anterior pair rarely visible, posterior pairs deeply incised, oblique, and progressively longer, the posteriormost pair reaching almost

to the center and turning from its oblique course to curve more strongly backward in so doing; occipital furrow deep laterally, wider and shallower at center; occipital ring about the same width laterally as the rim, thickens toward center and rises to a posteriorly directed protuberance; rim slightly wider at center than laterally, its anterior margin more often angular than evenly curved; brim convex and over twice width of rim; fixed cheeks high and narrow, less than one third width of glabella, and in transverse profile flat-topped but greatly depressed both anteriorly and posteriorly; palpebral lobes unknown; ocular ridge absent; posterolateral limbs long and narrow, curved slightly backward and traversed by a deep broad furrow.

Facial suture intramarginal almost to center; from the anterior corners proceeds directly backward and makes a slight indentation at a point opposite the lateral extremity of the middle glabellar furrow; course around the palpebral lobes unknown; halfway between posteriormost glabellar and occipital furrows it proceeds outward at an angle of about 80° with the longitudinal axis; opisthoparian.

COMPARISONS. Berkeia wichitaensis is typical of the second group of Berkeia species (vid. discussion of Berkeia glabellamersa), differing from Berkeia typica Resser and B. glabellamersa Wilson n. sp. in its narrower fixed cheeks. It closely resembles B. angustata Resser. From the descriptions in Resser's paper (1942, pp. 92, 93) no

differences are apparent, although the figures (pl. 15, figs. 31-33 and 34-39) show the convexity of the cranidium to be greater in B. angustata.

OCCURRENCE. Originally described from the Honey Creek limestone of the Wichita Mountains, Oklahoma. Abundant in the basal 35 feet of the Cameraspis zone of the Wilberns limestone in the Central Mineral Region of Texas; one poor specimen possibly representing the species was found in the Welge sandstone. The species is absent in the upper part of the Cameraspis zone of the Wilberns. Stations 2w.1, Lion Mountain; 4w.1? and 4w.6, Packsaddle Mountain; 7w.2, 7w.4, 7w.6, White Ranch Road; 8w.2, Marble Falls-Burnet Highway; 9w.3-9w.11, Baldy Mountain; 10w.6, 10w.7, Smoothingiron Mountain; 12w.1, 12w.2, 12w.5, 12w.8, Threadgill Creek; 13w.2, 13w.3, 13w.7?, Camp San Saba.

HYPOTYPES LPT-17, Sta. 12w.2, Threadgill Creek; LPT-18, Sta. 10w.7, Smoothingiron Mountain; LPT-19, Sta. 9w.4, Baldy Mountain; LPT-20, Sta. 8w.2, Marble Falls-Burnet Highway.

Berkeia glabellamersa Wilson, n. sp.
Plate 2, figures 1-4

Cranidium slightly longer than wide, only moderately convex. Glabella tapers anteriorly to an evenly rounded front, is almost as long as wide and of slight convexity; circumglabellar furrow very wide and deep, causing the low glabella to have a sunken appearance; glabellar furrows

oblique, moderately short and three in number, the anterior one visible only on specimens without the carapace; occipital furrow deep and narrow at sides, widening slightly and becoming more shallow at center; occipital ring somewhat wider at center than on sides and arched backward slightly. Rim well defined by a deep wide marginal furrow; brim convex, twice width of rim, the whole frontal limb being equal to half the length of glabella; fixed cheeks rise abruptly toward palpebral lobes, are convex and at middle are almost half width of glabella; palpebral lobes long and crescent shaped, extending from a point just anterior to lateral end of middle glabellar furrow to point half-way between lateral ends of posterior glabellar and occipital furrows; ocular ridge indistinct; posterolateral limbs narrow, short, distinctly furrowed, and make a right angle with the longitudinal axis of cranidium.

Facial suture intramarginal half-way to center; from anterior margin curves outward to marginal furrow, whence it curves slightly inward for a short distance to anterior end of palpebral lobe, continues down the outer edge of palpebral lobe to its posterior end, where it turns abruptly and proceeds straight outward.

Free cheeks and pygidium unknown.

REMARKS AND COMPARISONS. From a study of photographs and descriptions it appears that species of the genus Berkeia may be divided into three groups, one of which

consists of Berkeia typica Resser (genotype), B. saratogoensis Resser, and B. glabellamersa. This group is characterized by fixed cheeks almost half the width of the glabella, and by a brim at least twice the width of the rim. The second group differs from the first in having narrower fixed cheeks, that are not over one-third the width of the glabella, and is typified by B. wichitaensis Resser, B. missouriensis Resser, et al. The third group, of which B. nevadaensis Resser and B. affinis (Walcott) (Resser 1937, p. 14, 1942 pp. 91, 96, 1942a p. 7) are examples, differs from the others in having a rim equal in width to the brim, but fixed cheeks that are narrow.

Berkeia glabellamersa is similar to the genotype B. typica, but is only a third as large and possesses a cranidium of much less convexity because of the low glabella. The species compares favorably with B. saratogoensis Resser in size, but the latter species, like B. typica Resser, has a much more convex cranidium.

OCCURRENCE. Rare in the middle portion of the Cameraspis zone of the basal Wilberns limestone of Texas (the Modocia-Burnetia subzone), 30 to 45 feet above the base of the formation. Stations 4w.9, Packsaddle Mountain; 7w.7, 7w.8, White Ranch Road; 8w.4, Marble Falls-Burnet Highway; 9w.12, Baldy Mountain.

HOLOTYPE LPT-21, Sta. 7w.8, White Ranch Road; paratypes LPT-22, Sta. 8w.4, Marble Falls-Burnet Highway and LPT-23, Sta. 4w.9, Packsaddle Mountain.

Genus IDDINGSIA Walcott 1924

Iddingsia alpersensis Resser
Plate 2, figures 5-9

Iddingsia alpersensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 88, pl. 16, figs. 33-38.

ORIGINAL DESCRIPTION. The glabella is rounded in front and practically without furrows. The brim width is about half the length of the glabella including the thickened neck ring, which carries a long spine. Because of the circular anterior outline of the cranidium and the comparatively much less curved anterior furrow, the rim widens appreciably toward the center, where its width is about equal to the preglabellar area. At the anterior end of the eye the fixigene is about one-third the glabellar width. In this species the eyes are not so strongly bowed, nor do they extend back to the occipital furrow. As a whole the cranidium has considerable convexity. In the rear the glabella stands high above the dorsal furrow, but this relationship decreases anteriorly. Thus a forward slope of the whole is created, which is continued by the convex preglabellar area. The wide flat rim rises somewhat above a horizontal position. A slight rise brings the fixigenes up to the palpebral lobes. Anterior angles depressed. Preglabellar area marked by strong anastomosing lines.

Cranidium large, wider than long, its anterior end moderately convex. Glabella only slightly tapered, rounded in front, transversely convex, its posterior end standing high above fixed cheeks, its anterior end more depressed; circumglabellar furrow deep and wide along sides, becoming less distinct in front of glabella; glabellar furrows three in number, long, faint, and all curved posteriorly; occipital furrow shallow but wide; occipital ring parallel-sided,

arched backward, and frequently bearing a long spine that rises at a 15° angle. Rim slightly concave, crescent-shaped, its width equal to or greater than that of the brim, its anterior border separated from the inner portion by a faint groove paralleling the stronger marginal furrow; brim wide, together with rim equal to length of glabella, its convexity continuing the gentle slope of the anterior portion of the glabella; fixed cheeks half as wide as glabella, slope gently upward from circumglabellar furrow, posteriorly depressed; palpebral lobes curved strongly outward, situated opposite posteriormost pair of glabellar furrows, separated from a small lateral protuberance of the fixed cheeks by a distinct furrow; ocular ridges prominent, originating opposite anterior pair of glabellar furrows; posterolateral limbs long and narrow, extended at a 90° angle to longitudinal axis, and traversed by a wide furrow.

Facial suture intramarginal almost to center of cranidium, rounds anterior corners and proceeds slightly inward to a point anterior to palpebral lobes whence it proceeds sharply outward, bends around palpebral lobes, indents again posterior to the lobes, and passes straight outward along margin of posterolateral limbs; opisthoparian.

Surface of brim and rim marked by fine anastomosing ridges.

Free cheeks and pygidium unknown.

REMARKS AND COMPARISONS. Iddingsia alpersensis as described by Resser possesses an occipital spine. The

Texas specimens resemble closely those from Oklahoma, but half of them have completely smooth occipital rings. They agree in all other respects. Iddingsia alpersensis differs from I. nevadaensis Resser, with which it is associated, in being less convex, possessing less elevated fixed cheeks, shallower glabellar furrows, and a less distinct occipital ring.

OCCURRENCE. Found in the basal 35 feet of the Cameraspis zone of the lower Wilberns limestone. In some places it is very abundant and is, in general, the most prominent member of the lower Cameraspis fauna. It is associated with I. nevadaensis Resser and Berkeia wichitaensis Resser. Stations 2w.1-2w.5, Lion Mountain; 7w.2, White Ranch Road; 9w.4-9w.7 and 9w.11, Baldy Mountain; 11w.13, Hye; 12w.1, 12w.2, 12w.7, Threadgill Creek; 13w.1, Camp San Saba.

HYPOTYPES LPT-24, Sta. 2w.4 and LPT-25, Sta. 2w.5, Lion Mountain; LPT-26, Sta. 12w.2, Threadgill Creek.

Iddingsia nevadaensis Resser
Plate 2, figures 10-13

Iddingsia nevadaensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 85, pl. 16, figs. 15-17.

ORIGINAL DESCRIPTION. A cranidium and libragene which were previously identified as I. robusta, differ from that species in several respects. I. nevadaensis is characterized by the usual large glabella on which the rear pair of furrows are deep and the next pair short and shallow. A wide

occipital furrow separates a prominent neck ring. At the anterior end of the eye the fixigenes are about one-third the glabellar width. In width the brim is just half the length of the glabella including the neck ring. It is divided about equally into a somewhat convex preglabellar area and a slightly thickened rim. Longitudinally the cranidium is convex, the glabella having a nearly even curvature except toward the front, where there is a slight decrease. On the other hand the brim as a whole is moderately concave. In cross section the glabella is convex, and the libragenes rise from the dorsal furrow rather steeply. The anterior angles are sharply depressed. Likewise the posterolateral limbs appear to have been considerably depressed. The associated libragene has a large ocular platform and a rim to match the brim width. A heavy genal spine of unknown length is built from the heavy rim and the thickened near portion of the cheek.

This species differs from I. robusta in its longer glabella and relatively narrower rim. In I. robusta the brim as a whole continues the downward slope of the anterior half of the glabella, thus giving the cranidium much greater convexity.

SUPPLEMENTARY DESCRIPTION. Cranidium large and very convex. Glabella large, long, highly arched, untapered but rounded anteriorly, its frontal half sloping steeply downward; circumglabellar furrow deep; two pairs of glabellar furrows present: anterior pair short, distinct, and slightly oblique; posterior pair much deeper, longer, and deflected backward; occipital furrow deep and wide, more incised laterally than at center; occipital ring slightly tapered laterally and arched forward. Rim as wide as brim, untapered and flat, well defined by a wide marginal furrow, its anterior margin describing a wide arc; brim continuing the steep downward slope of the anterior portion of the cranidium, everywhere

of equal width, the complete frontal limb accounting for one-third total length of cranidium; fixed cheeks at widest point about one-third width of glabella, slope up steeply from circumglabellar furrow; palpebral lobes as long as rim is wide, elevated above fixed cheeks, widely crescent shaped, extend from opposite occipital furrow to a point midway between glabellar furrows, separated from fixed cheeks by broad furrows; ocular ridges faint and very oblique; posterolateral limbs narrow and moderately depressed, extended at right angles to longitudinal axis, broadly and deeply furrowed, lateral extremities unknown.

Facial suture indents sharply at lateral extremity of marginal furrow, bows outward a short distance before again indenting anterior to palpebral lobe, curves around palpebral lobe, and proceeds outward along anterior margin of posterolateral limb.

Pygidium semi-ellipsoidal in outline; anterior margin curved gently posteriorly to meet wide arc of posterior margin at rounded corners lateral to middle axial ring; axis prominent, extends almost to posterior margin, possesses three strong rings and a large terminal segment; pleural lobes wider than axis, each made up of two strong segments, slope posterolaterally to a flat, moderately wide, unsegmented brim; rim unknown, possibly absent along posterior margin, prominent anterior to the lateral corners.

REMARKS. All specimens found are fragmentary. Two pygidia were closely associated with a cranidium at a

station (8w.2) that produced no other fossils except Elvinia roemeri (Shumard). The pygidium resembles that of E. roemeri (Shumard), but is wider and has a relatively narrower axis. Resser (1942, p. 85) has pointed out the differences between I. nevadadensis Resser and I. robusta (Walcott).

OCCURRENCE. Rare in the lower portion of the Cameraspis zone, 15 to 30 feet above the base of the Wilberns limestone where it is associated with Berkeia wichitaensis Resser and Iddingsia alpersensis Resser. Stations 3w.2, White Creek; 8w.2 Marble Falls-Burnet Highway; 9w.10, Baldy Mountain.

HYPOTYPES. LPT-27, Sta. 3w.2, White Creek; LPT-28 (cranidium) and LPT-29 (pygidium), Sta. 8w.2, Marble Falls-Burnet Highway.

Family SOLENOPLEURIDAE Angelin

Genus ACROCEPHALITES Wallerius 1895

Acrocephalites gouldi Frederickson MS.
Plate 2, figures 14,15

Acrocephalites gouldi FREDERICKSON, 1942 Thesis MS., University of Wisconsin, The Cambrian Stratigraphy of Oklahoma, pp. 79,80, pl. 2, figures 39,40.

ORIGINAL DESCRIPTION. Cranidium broader than long, keeled; glabella four-fifths length of cranidium, convex, tapering at sides, roundly truncated anteriorly; three pairs of glabellar furrows, anterior pair very faint, others impressed, oblique; occipital furrow and ring well defined; no occipital node or spine, but slight transverse ridge from continuation of glabellar keel; dorsal furrow narrow,

moderately deep. Fixed cheeks one-half as wide as glabella, nearly flat at eyes but sloping steeply anteriorly and posteriorly; palpebral lobes large, rounded, located approximately between posterior two pairs of glabellar furrows; faint ocular ridge continuing curvature of palpebral lobe; frontal limb of moderate width, convex, separated from pointed convex, triangular-shaped, upturned frontal rim by straight, well defined transverse furrow. Posterolateral limbs sloping steeply away from glabella and palpebral lobe, convex, marked by prominent intramarginal furrow. Free cheek not known.

Facial suture expands very slightly forward from palpebral lobes; posteriorly it cuts the margin within the genal angle.

Cranidium 6 mm. long, 10 mm. wide across posterolateral limbs. Surface of test minutely granulose.

REMARKS AND COMPARISONS. Acrocephalites gouldi is represented in the Texas collection by two fragmentary cranidia, the characters of which add nothing to Frederickson's description except that the central portion of the very convex rim is gradually expanded along its posterior as well as anterior margin, giving the rim a slightly bulbous appearance. Acrocephalites gouldi superficially resembles the Conaspid Stigmacephalus but differs from it mainly in the shape of the postorolateral limbs and the structure of the rim.

OCCURRENCE. Frederickson describes the species from the Eoorthis zone of the Honey Creek limestone of Oklahoma. He places the horizon as 5 feet above the Irvingella zone. In Texas Acrocephalites gouldi is present in the

Irvingella zone, 1 to 3.5 feet below the top of the Cameraspis zone of the basal Wilberns limestone. Stations 12w.13 and 12w.14, Threadgill Creek.

HYPOTYPES LPT-31, Sta. 12w.13 and LPT-30, Sta. 12w.14, Threadgill Creek.

Acrocephalites benesulcatus Wilson n. sp.
Plate 2, figures 16-19

Cranidium of average size, almost twice as wide as long, moderately convex. Glabella prominent, well tapered, convex and keeled, flat in longitudinal profile and only slightly depressed at its anterior end; circumglabellar furrow extremely wide and deep, particularly so on specimens without the carapace; three pairs of glabellar furrows, short and oblique, becoming progressively longer and deeper posteriorly; occipital furrow straight, slightly deeper at sides than at center; occipital ring wide, arched slightly forward laterally and somewhat tapered. Rim convex, well defined by distinct marginal furrow, triangular, being greatly expanded at center along its anterior and slightly so along its posterior margins; brim immediately anterior to glabella slightly arched and about half width of centrally expanded rim, widens considerably at sides where it is depressed to anterolateral corners; fixed cheeks between a third and a half as wide as glabella, their lateral edges greatly elevated; palpebral lobes short, small, unelevated, and situated approximately lateral to area between posteriormost

pairs of glabellar furrows; ocular ridges faint and oblique; posterolateral limbs very wide, straight, greatly depressed, widely and deeply furrowed.

Facial suture intramarginal to center, proceeds slightly outward from anterolateral corners of cranidium to palpebral lobe around which it curves and then continues its outward course at a sharper angle along anterior margin of posterolateral limbs.

Free cheek and pygidium unknown.

Surface granulation either minute or absent.

REMARKS AND COMPARISONS. Acrocephalites benesulcatus differs from A. gouldi Frederickson, with which it is associated, in its narrower brim and greatly elevated fixed cheeks. It lacks a definite tubercule anterior to the glabella, and its triangular rim is a striking character.

OCCURRENCE. Numerous specimens were found at a single locality in the Irvingella subzone, 3 feet below the top of the Cameraspis zone of the basal Wilberns limestone. Station 12w.14, Threadgill Creek.

HOLOTYPE LPT-32 and paratypes LPT-33 and LPT-34, Sta. 12w.14, Threadgill Creek.

Acrocephalites lataegenae Wilson, n. sp.
Plate 2, figure 20

Cranidium very small (4.5 by 3 mm.), wider than long, and highly convex. Glabella sunken, sharply crested, taptered anteriorly to two-thirds its basal width, length

about half that of entire cranidium; circumglabellar furrow deep and wide; three pairs of glabellar furrows present: anterior pair faint, but posterior pairs long, oblique, and unusually wide and deep; occipital furrow straight and as wide and deep as glabellar furrows; occipital ring wide medially but tapers sharply laterally. Rim short, convex, sharply defined by distinct marginal furrow, and well tapered laterally; brim twice as wide as rim at center and one-third length of glabella, strongly depressed laterally, and bears a large swelling immediately anterior to the glabella; fixed cheeks two-thirds as wide as glabella, greatly elevated at lateral edges, depressed posteriorly; palpebral lobes missing; ocular ridges wide, prominent, and arched horizontally across anterior ends of fixed cheeks; posterolateral limbs straight, moderately wide, very long, greatly depressed, and traversed by furrows that widen noticeably toward their extremities.

Facial suture proceeds slightly outward from antero-lateral corner of cranidium to lateral extremity of ocular ridge, course around palpebral lobe unknown, but it trends posterolaterally at an angle of 45° with the longitudinal axis along the anterior margin of the limb.

Palpebral lobe, free cheek and pygidium unknown.

Surface granulation coarse.

REMARKS AND COMPARISONS. Of the three species of Acrocephalites in the Wilberns limestone, A. lataegenae most resembles the genotype, A. stenometopus Angelin, in

that it possesses a noticeable preglabellar swelling, wide fixed cheeks, and coarse surface granulation. Its small size and deep wide glabellar furrows are outstanding characteristics of A. lataegenae. The importance of the presence of true Acrocephalites species in the Ironton equivalents of North America has been pointed out by Howell and Lochman (1939 pp. 115-117 and 120, 121.)

OCCURRENCE. Represented by a single specimen from a bed of Cameraspis convexa (Whitfield) in the middle portion of the Cameraspis zone, 31.6 feet above the base of the Wilberns limestone. Station 13w.6, Camp San Saba.

HOLOTYPE LPT-35, Sta. 13w.6, Camp San Saba.

Family UNDETERMINED

Genus CAMERASPIS Ulrich and Resser 1924

Cameraspis convexa (Whitfield)
Plate 2, figures 21-23

Arionellus (Agraulos) convexus WHITFIELD, 1878, Wisconsin Geol. Survey, Ann. Rept. for 1877, p. 57.

Arionellus convexus WHITFIELD, 1882, Geology Wisconsin, vol. 4, p. 190, pl. 1, fig. 17.

Cameraspis convexus (Whitfield) ULRICH and RESSER MS., Ulrich, 1924, Wisconsin Acad. Sci., Arts, and Letters, vol. 21, p. 94.

Cameraspis convexa (Whitfield) FREDERICKSON, 1942, MS. Thesis, University of Wisconsin, Cambrian Stratigraphy of Oklahoma, pp. 90-92, pl. 1, figs. 15-17. (Complete synonymy that includes Cameraspis hemisphericus (Berkey) in this species.)

ORIGINAL DESCRIPTION. Glabella and fixed cheeks when united, strongly convex and somewhat paraboloid in form, length and width nearly equal; anterior margin of the head, between the suture lines, regularly and somewhat sharply arcuate; palpebral lobes small, not very prominent, situated posterior to the middle of the head. Glabella rather less than two-thirds of the entire length of the shield, round-conical in form, and somewhat abruptly tapering, scarcely defined at the margins by the dorsal furrows, and apparently very indistinctly marked by three pairs of oblique furrows; occipital ring narrower than the base of the glabella, and more prominent, and also extending beyond the posterior limits of the fixed cheeks; occipital furrow very shallow and faintly marked, the ring short in the middle, and reduced to its minimum width at its junction with the dorsal furrows. Fixed cheeks half as wide as the glabella; frontal limb as long in the middle as the width of the fixed cheeks, and slightly increasing toward the lateral angles. Facial suture passing nearly direct from the eye to the anterior margin of the head, its course posterior to the eye not determined.

The largest example of the glabella and fixed cheeks observed measures about three-fourths of an inch in length by nearly seven-eighths of an inch in width at the base. No other parts of the organism have been observed.

Cranidium one and a half times as wide as long, strongly convex both transversely and longitudinally, its general appearance smooth, there being no individually convex features on it. Glabella low and flat, barely rising above fixed cheeks, having in some specimens a thin ridge along its longitudinal crest, anteriorly depressed, following in that direction the general downward curvature of the cranidium; circumglabellar furrow wide and very shallow; glabellar furrows absent in almost all specimens, traces of three oblique pairs visible on a few individuals; occipital furrow straight and

shallow; occipital ring widens very gradually to center. Rim flat and faint, defined by an almost invisible marginal furrow, its width about half that of brim, its anterior margin describing a wide arc; brim moderately wide, its preglabellar width almost equal that of its lateral portions', and in longitudinal profile continues the downward slope of the anterior part of glabella; fixed cheeks half width of glabella, longitudinally depressed in both directions, perfectly flat or gently sloping away from glabella in transverse profile; palpebral lobes depressed, small, crescent-shaped, their anterior ends about at the transverse median line of cranidium; ocular ridges faint, their course almost paralleling that of the marginal furrow; posterolateral limbs short, extended at right angles to longitudinal axis, traversed by a shallow furrow which widens and becomes more distinct laterally.

Facial suture passes slightly inward in proceeding from anterolateral corner of cranidium to anterior end of palpebral lobe, rounds palpebral lobe, indents slightly just behind it and passes posterolaterally along anterior margin of the limb.

Free cheeks and pygidium unknown.

REMARKS. Although Frederickson (1942 MS., pp. 93, 94) names in addition to the well-known genotype, Cameraspis convexa (Whitfield), two other species of the genus (C. plana and C. parabola) based upon varying degrees of convexity,

the Texas specimens are wholly identical with the genotype. The larger forms from the Welge sandstone are not quite so convex as the others, probably a circumstance resulting from differences in matrix rather than any structural differences in the fossils.

OCCURRENCE. Moderately abundant in the Welge sandstone, seemingly absent in the lower 30 feet of the Wilberns limestone, abundant in the middle portion of the Cameraspis zone 30 to 55 feet above the base of the Wilberns limestone, and present at one locality in the Irvingella zone. At most stations at which it was collected the species occurred in great abundance, often being the major constituent of a shell breccia composed solely of trilobite tests replaced by calcite. It is not so common in the Cameraspis zone of the Wilberns limestone as Elvinia roemeri (Shumard), but it is a good marker, and the fauna of this zone has long been known by the name of the genus. Stations 2w.8, Lion Mountain; 3w.4, 3w.10, 3w.11, White Creek; 4w.9, 4w.10, Packsaddle Mountain; 6w.4, Backbone Ridge; 7w.7, 7w.8, White Ranch Road; 8w.4, Marble Falls-Burnet Highway; 9w.12, 9w.13, Baldy Mountain; 10w.5, Smoothingiron Mountain; 11w.8, 11w.9, Hye; 12w.4, 12w.5, 12w.13, Threadgill Creek; 13w.6-13w.9, Camp San Saba.

HYPOTYPES LPT-36 and LPT-37 (two cranidia on same piece of rock), and LPT-38, Sta. 13w.6, Camp San Saba.

Genus CHEILOCEPHALUS Berkey 1898

Cheilocephalus wichitaensis Resser
Plate 2, figures 24, 25

Cheilocephalus wichitaensis Resser, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 35, pl. 5, fig. 39.

ORIGINAL DESCRIPTION. Several cranidia of this interesting genus have been found in the Oklahoma collections. It is a very simple trilobite, the cranidium consisting of a large glabella with no furrows except a shallow occipital furrow. The fixigenes are simple. The glabella tapers slightly to a nearly straight anterior margin. In cross section it stands well above the dorsal furrow, rising at a fairly even rate to approximately the center. Longitudinally, the head has considerable relief, attained by even curvature. The brim is narrow and consists of a simple, slightly concave, and nearly horizontal extension, the outer edge of which is very slightly thickened but does not form a rim. The fixigenes have nearly the same width throughout, and are about equal to one-fourth the glabellar width. Test smooth.

Compared to C. stcroixensis the Oklahoma species is slightly smaller and differs in the distribution of convexity in both directions.

Cranidium of very simple structure, moderately convex, evenly arched in transverse profile. Glabella very large and tapered slightly, its anterior corners rounded, frontal margin straight, transverse profile evenly convex, and in longitudinal profile gently depressed anteriorly; circumglabellar furrow narrow but distinct; glabellar furrows absent; occipital furrow faint; occipital ring widest at center. Rim absent; brim concave and narrow, its width about one-fifth length of glabella; fixed cheeks slightly wider than brim, slope gently to merge with it and slope

gradually away from glabella to continue its even arch; posterolateral limbs long and comparatively wide, evenly depressed away from glabella, and traversed by a wide and shallow furrow.

Facial suture rounds anterolateral corner, proceeds posteriorly a short distance, bends outward at a point anterior to medial axis of glabella and then passes abruptly inward to make a sharp indentation just before proceeding posterolaterally at a 70° angle with the longitudinal axis.

COMPARISONS. Cheilocephalus wichitaensis differs from the genotype, Cheilocephalus stcroixensis Berkey, in having a somewhat smaller cranidium with less convexity and longer and narrower posterolateral limbs.

OCCURRENCE. Two specimens of Cheilocephalus wichitaensis were found at a single locality (7w.2, White Ranch Road) in the basal part of the Cameraspis zone of the Wilberns limestone. The species was originally described from the Honey Creek limestone of Oklahoma where it is associated with species of Irvingella and Elvinia. Of the other species of the genus, the genotype C. stcroixensis Berkey is probably associated with the Ironton fauna (Berkey 1898, p. 289), and C. buttsi Resser (1942, p. 36) is from the Ore Hill limestone of Pennsylvania, an Ironton equivalent. In addition, Resser (1942, p. 35) has described C. texanus from the Hickory sandstone of Texas, a formation that carries a Cedaria fauna.

HYPOTYPE. LPT-39, Sta. 7w.2, White Ranch Road.

Genus COENASPIS Resser 1938

Coenaspis sp.
Plate 2, figures 26,27

Cranidium very convex, twice as wide as long. Glabella large, tapered to an arcuate front, occupies well over half length of cranidium excluding occipital ring, evenly convex transversely, longitudinal profile unknown; circumglabellar furrow deep at sides, less distinct anteriorly; two pairs of faint glabellar furrows probably present; occipital furrow about same width and depth as circumglabellar furrow; occipital ring straight, widening only slightly at center. Rim flat, well defined by a deep marginal furrow, widely arcuate, and greatly tapered laterally; brim convex, slightly narrower than rim; fixed cheeks as wide as glabella, rise laterally from circumglabellar furrow until their edges are elevated above dorsal surface of glabella; palpebral lobes unknown; ocular ridges oblique, narrow, and indistinct; posterolateral limbs unknown.

Facial suture intramarginal almost to center, rounds anterolateral corner and proceeds straight backward, indenting slightly at lateral extremity of ocular ridge; further course unknown.

Free cheek and pygidium unknown.

Surface of cranidium coarsely granulate.

REMARKS AND COMPARISONS. The identification of Coenaspis sp. is based upon one incomplete cranidium from

which the palpebral lobes, posterolateral limbs, and top of the glabella are missing. The specimen resembles C. aldenensis Frederickson MS. (1942, p. 44) except that the brim is wider and the glabella is slightly narrower than in the Oklahoma species. The surface granulation is more apparent where the cranidium has been exfoliated.

OCCURRENCE. The single specimen was found high in the Cameraspis zone of the Wilberns limestone associated with Cameraspis convexa (Whitfield), Elvinia roemeri (Shumard), and Dokimocephalites extensus (Resser). Station 4w.10, Packsaddle Mountain.

HOLOTYPE LPT-40, Sta. 4w.10, Packsaddle Mountain.

Genus DUNDERBERGIA Walcott 1924

Dunderbergia ? declivita Miller
Plate 2, figures 28-31

Dunderbergia ? declivita MILLER, 1936, Jour. Paleontology, vol. 10, no. 1, p. 30, pl. 8, figs. 37,38.

ORIGINAL DESCRIPTION. Cranidium characterized by small posterolateral limbs and steeply inclined frontal limb. Glabella strongly and evenly convex, subconical, rounded anteriorly; glabellar furrows represented by two pairs of very faint, poorly defined depressions, anterior pair transverse, extending from base about halfway to the crest of glabella; posterior pair slightly longer, curved backward. Preglabellar area bulging slightly just anterior to circumglabellar furrow, then inclining rapidly and merging into frontal furrow. Rim narrow, widening toward center owing to intramarginal course of facial suture. Fixed cheeks narrow, flattened, forming a nearly level platform along sides of glabella. Eye lines present; palpebral lobes prominent, located opposite middle of glabella. Occipital ring flattened, about twice width of furrow.

Free cheek, thorax, and pygidium unknown. Minute granules dot the upper part of the glabella, becoming less numerous along sides; rest of surface apparently smooth.

Comparisons. Although D. declivita may represent a new genus, it has the same general characteristics as D. nitida (Hall and Whitfield), and because of the scanty material available for study it is believed advisable to refer the species to Dunderbergia. It differs from D. nitida in that the border is more steeply inclined from the glabella to the rim, not convex as in D. nitida; and in the flat, platform-like form of the cheeks bordering the sides of the glabella.

REMARKS. In addition to the features described by Miller, the Texas specimens possess a third anterior, transverse and very faint pair of glabellar furrows (not visible on all specimens), and an essentially untapered, almost tumid glabella. The Texas and Wyoming specimens seem otherwise identical. From a study of descriptions and illustrations it appears to the writer that the species under discussion more closely resembles Deadwoodia panope (Walcott) (Resser 1938, p. 29) than it does Dunderbergia nitida (Hall and Whitfield). In addition to the differences pointed out by Miller, the flaring frontal limb, wide brim, and small palpebral lobes of D. nitida would seem to distinguish it from D. ? declivita. On the other hand the descriptions and figures of Deadwoodia panope (Walcott) (Walcott 1890, p. 275, pl. 21, fig. 13; Resser, 1938, p. 29) fit D. ? declivita very well, except that the frontal border is described as having a shallow anterior furrow "with the essentially flat rim turned nearly into a horizontal position"

(Resser 1938, p. 29). Unfortunately the only published illustration of Deadwoodia panope (Walcott) is a sketch accompanying the original description. It is interesting that although both Walcott's and Resser's descriptions picture the rim as flat with a shallow marginal furrow, the sketched profile shows a definitely upturned rim and a deep anterior groove exactly as in D. ? declivita.

OCCURRENCE. According to Miller the species is found in Wyoming in the Elvinia beds of the Gallatin formation in the Teton and Gros Ventre Mountains. In Texas it is present at one locality in the lower portion of the Cameraspis zone, where it is associated with Iddingsia alpersensis Resser, Berkeia wichitaensis Resser and Irvingella sp. At most localities where found the species was present but not common in the middle portion of the Cameraspis zone. Its total vertical range was from 25 to 55 feet above the base of the Wilberns limestone. Stations 9w.9, 9w.10, Baldy Mountain; 10w.7, Smoothingiron Mountain; 12w.2, 12w.10, Threadgill Creek.

HYPOTYPES LPT-43, Sta. 12w.2 and LPT-42, Sta. 12w.10, Threadgill Creek; LPT-41, Sta. 9w.9, Baldy Mountain.

Genus ELVINIA Walcott 1924

Elvinia roemeri (Shumard)
Plate 3, figures 1-5

Dikelocephalus roemeri SHUMARD, 1861, Am. Jour. Sci., 2nd ser., vol. 32, pp. 220,221.

Elvinia roemeri (Shumard) WALCOTT, 1924, Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, pl. 11, fig. 3.

Elvinia roemeri (Shumard) BRIDGE, 1937 U.S. Geol. Survey, Prof. Paper 186-M, pp. 251-255, (complete synonmy to date, full discussion of species), pl. 69, figs. 1-21.

Elvinia roemeri (Shumard) FREDERICKSON, 1942, Thesis MS., University of Wisconsin, The Cambrian Stratigraphy of Oklahoma, pp. 68-70, pl. 1, figs. 1-5.

REMARKS. Although Resser (1937, p. 12; 1938, pp. 30-33; 1942, pp. 94-99) has identified fourteen species of the genus Elvinia, both Bridge (1937, p. 254) and Frederickson (1942, p. 69) have pointed out that various ontogenetic stages of Elvinia roemeri may easily be mistaken for different species. Believing this true and holding to the tenet that multitudes of new species are valueless unless of stratigraphic significance, all the Texas material has been identified as Elvinia roemeri.

OCCURRENCE. Elvinia roemeri is by far the best index species to the Cameraspis zone. It is the largest and most abundant species of the fauna in Texas. It is present but not common in the Welge sandstone and lower portion of the zone, most abundant in the middle subzone, 30 to 45 feet above the base of the Wilberns formation, and present at one locality in the Irvingella zone, 6 feet below the base of the Eoorthis-Billingsella bed. Stations 2w.2,

2w.4, 2w.7, 2w.8, Lion Mountain; 3w.2-3w.4, 3w.8, 3w.10, White Creek; 4w.7, 4w.9, 4w.10, Packsaddle Mountain; 6w.1, 6w.4, Backbone Ridge; 7w.2, 7w.4, 7w.7, 7w.8, 7w.10, 7w.11, White Ranch Road; 8w.2, 8w.3, Marble Falls-Burnet Highway; 9w.1, 9w.5-9w.7, 9w.9, 9w.12-9w.14, Baldy Mountain; 10w.6, 10w.7, Smoothingiron Mountain; 11w.6-11w.9, 11w.13, Hye; 12w.2, 12w.3, 12w.5, Threadgill Creek; 13w.1, 13w.3-13w.9, 13w.11, Camp San Saba.

HYPOTYPES LPT-44 (large cranidium), Sta. 10w.6, Smoothingiron Mountain; LPT-47 (cranidium), Sta. 3w.2, White Creek; LPT-46 (pygidium), Sta. 13w.6, Camp San Saba; LPT-45 (free check), Sta. 12w.4, Threadgill Creek.

Genus MODOCIA Walcott 1924

Modocia wilbernsensis Wilson n. sp.
Plate 3, figures 6-11

Length of cranidium approximately 70 per cent of width across posterolateral limbs; longitudinal convexity moderate. Glabella as long as wide, tapered slightly anteriorly, in longitudinal profile rising abruptly above occipital furrow and sloping gently downward anteriorly; three pairs of glabellar furrows usually present but faint on specimens with carapace preserved, stronger on exfoliated specimens: anterior pair frequently not visible, posterior pairs usually so, the last pair most distinct and abruptly curved backward; circumglabellar furrow narrower than occipital furrow, but deep and distinct throughout its course; occipital furrow

wide at longitudinal axis, swings slightly back and then forward to connect with circumglabellar furrow, becoming deeper and narrower in so doing; occipital ring thickest at center and arched slightly backward. Rim rounded in transverse profile, made distinct by a deep marginal furrow, tapered only slightly at ends; brim one and a half times width of rim, its convexity continuing the long downward slope of the anterior two-thirds of glabella; fixed cheeks a little less than one-third of glabella and only slightly raised above circumglabellar furrow, their longitudinal convexity moderate and transverse profile flat; palpebral lobes slightly convex laterally, extending from a point lateral to mid-glabellar furrow to point lateral to most posterior ones; ocular ridges strong in best preserved specimens, faint in others, oblique, originate lateral to most anterior glabellar furrow; posterolateral limbs wide, 70 per cent as long as width of base of glabella, broadly and deeply furrowed.

Facial suture intramarginal about halfway to center of cephalon, curves sharply around anterolateral corners of cranidium and inward to a point lateral to middle glabellar furrow, curves slightly around palpebral lobes and trends posterolaterally at an angle of 30-40° with longitudinal axis; opisthoparian.

Free cheeks and pygidium not unknown.

Surface granulation present or absent.

REMARKS AND COMPARISONS. *Modocia wilbernsensis* is the most abundant species of the genus in the Wilberns limestone. It greatly resembles *M. juvenalis* Frederickson MS., but is at least twice as large and possesses glabellar furrows. A specimen slightly below average size measures 10 mm. in width at base of cranidium and 7 mm. in length along longitudinal axis; the largest specimen found measures 12.5 by 9 mm.

Modocia probably is represented by several species in the basal Wilberns limestone, but the specimens were not sufficiently good to warrant other descriptions.

OCCURRENCE. Raasch and Lochman (1943, p. 233) have the following to say concerning the range of *Modocia*.

> The occurrence of a species of *Modocia* in the fauna of subzone III of the *Crepicephalus* zone extends the range of the genus considerably. *Modocia* is especially characteristic of the middle *Cedaria* zone in the Cordilleran region, but in the Black Hills it occurs in an assemblage of either late *Cedaria* or very early *Crepicephalus* zone. Its appearance in Zone I in Wisconsin indicates that the genus was moving slowly eastward along the southern shore of Laurentia during early Upper Cambrian time. Apparently, however, it was never able to penetrate beyond Wisconsin as it has never been recorded from either of these zones or any later zones in Missouri, Texas, or the Southern Appalachians. It appears to have lingered on in Wisconsin during *Crepicephalus* zone time and finally disappeared with that fauna.

Apparently by *Cameraspis* zone time the genus had reached both Texas and Oklahoma. Whether it occurs in lower zones in these two states is as yet unknown.

Modocia wilbernsensis first appears in the Cameraspis zone of the Wilberns limestone about 30 feet above the base; most abundant from 30 to 45 feet above the base; present at a few localities in the Irvingella zone. Stations 3w.4, 3w.5, 3w.8, White Creek; 4w.9, Packsaddle Mountain; 7w.2, 7w.4, 7w.8, White Ranch Road; 8w.3, Marble Falls-Burnet Highway; 9w.12, 9w.15, Baldy Mountain; 11w.7 and 11w.8, Hye; 12w.11-12w.13 and 12w.15, Threadgill Creek; and 13w.6, Camp San Saba.

HOLOTYPE LPT-48, Sta. 4w.10, Packsaddle Mountain; paratypes LPT-49 and LPT-51, Sta. 12w.5, Threadgill Creek; LPT-50, Sta. 11w.7, Hye. Specimens differing from the general pattern of Modocia wilbernsensis; LPT-52, Sta. 3w.4; LPT-53, Sta. 7w.7; LPT-54, Sta. 7w.6.

Genus PTEROCEPHALIA Roemer 1849

Pterocephalia sanctisabae Roemer
Plate 3, figures 15-17

Pterocephalia sanctisabae ROEMER, 1849, Texas, p. 421.

Pterocephalia sanctisabae ROEMER, 1852, Die Kreidebildungen von Texas., p. 92, pl. 11, figs. 1a-d.

Pterocephalia sanctisabae Romer, BRIDGE, 1937, U.S. Geol. Survey, Prof. Paper 186-M, pp. 246-250 (complete synonymy to date, translation of Roemer's description, and discussion of species and genus), pl. 67, figs. 1a-d, pl. 2, figs. 9-13.

Pterocephalia sanctisabae Roemer, FREDERICKSON, 1942, Thesis MS., University of Wisconsin, The Cambrian Stratigraphy of Oklahoma, pp. 67,68, pl. 2, figs. 9-13.

REMARKS. Although Resser (1938, p. 39-41) identified nine species of Pterocephalia from other states, only P. sanctisabae is known from Texas. The specimens collected from the Wilberns limestone are fragmentary, but Bridge's excellent description and the distinctive character of the species made its identification certain.

OCCURRENCE. Present but not common in the middle portion of the Cameraspis zone, 30 to 50 feet above the base of the Wilberns limestone, where it is associated with Burnetia urania (Walcott), Dokimocephalites extensus (Resser), Cameraspis convexa (Whitfield), and Elvinia roemeri (Shumard). Stations 3w.3 and 3w.8, White Creek; 8w.3, Marble Falls-Burnet Highway; 9w.11, Baldy Mountain; 12w.5, 12w.11, 12w.12, Threadgill Creek; 13w.6, 13w.7, Camp San Saba.

HYPOTYPES LPT-55 (cranidium mould), Sta. 13w.6 and LPT-57 (fragmentary cranidium), Sta. 13w.7, Camp San Saba; LPT-56 (pygidium), Sta. 12w.11, Threadgill Creek.

Genus PTYCHOPLEURITES Kobayashi 1936

Ptychopleurites amplooculata Frederickson MS
Plate 3, figures 18-20

Ptychopleura amplooculata FREDERICKSON 1942, Thesis MS., University of Wisconsin, Cambrian Stratigraphy of Oklahoma, p. 70, pl. 2, figs. 41-44.

ORIGINAL DESCRIPTION. Glabella convex, slightly convergent and rounded anteriorly; three pairs of weak, oblique glabellar furrows; occipital furrow deeply impressed at sides of glabella and becoming faint in front. Fixed cheeks narrow but expanded widely at palpebral lobes which are elevated and elongate, extending from position anterior to second pair of glabellar furrows almost to occipital furrow; wide palpebral band separated from inner cheek by narrow furrow; faint ocular ridge; frontal limb narrow; frontal rim convex, elevated in the middle and decreasing only slightly in width at the extremities. Posterolateral limbs narrow, elongate, strap-like, with narrow, deep intramarginal furrow. Free cheek not known.

Facial suture cutting anterior margin at center, curving out around frontal rim, then converging to palpebral lobe around which it curves gently; thence sharply outward at nearly right angles to axial line and around posterolateral limb to posterior margin.

SUPPLEMENTARY DESCRIPTION. Cranidium convex very small, being about 3 by 4 mm., slightly wider than long, but if posterolateral limbs are excluded its length is about twice its width. Glabella long, two-thirds total length of cranidium excluding occipital ring, very convex, almost tumid, abruptly depressed anteriorly; circumglabellar furrow deep and narrow at sides, becoming more shallow in front of glabella; three pairs of weak glabellar furrows becoming progressively deeper, longer, and more oblique posteriorly; occipital furrow deep at sides, shallow at center, tapered and curved forward at sides. Rim flat, twice width of brim, only slightly tapered at sides, its anterior margin arcuate; brim extremely narrow anterior to glabella, widening laterally, slopes steeply up from distinct marginal furrow and

flat rim; fixed cheeks narrow, greatly constricted in width at point lateral to anteriormost pair of glabellar furrows, expanded posterior to this point, bowed outward, constricted again at point lateral to occipital furrow; palpebral lobes elongate, crescent shaped, wider than inner fixed cheeks from which they are separated by a distinct groove, proceed from the anterior to the posterior constriction of the fixed cheeks; ocular ridges short and faint; posterolateral limbs very long and narrow, extend at right angles to longitudinal axis, traversed by a distinct furrow.

Facial suture intramarginal to center, evenly rounds anterolateral corners of cranidium and is directed sharply inward at a point lateral to anteriormost pair of glabellar furrows, whence it proceeds widely around edge of long palpebral lobe to indent again at lateral extremity of occipital furrow, and proceed outward at right angles to longitudinal axis.

Free cheek unknown.

Associated pygidium semi-elliptical in outline, strongly convex; axis long, extends to border and stands well above pleural lobes, tapered posteriorly to about half its width at anterior margin, and marked by three strongly defined rings and a terminal segment; pleural lobes very convex, highly elevated above rim, marked by three segments that are traversed by faint secondary furrows; rim unsegmented, separated from the pleural lobes by an indistinct furrow, its

lateral width equal to half that of the pleural lobes, narrows centrally due to the indentation of its margin at the longitudinal axis, and continues the steep downward slope of the pleural lobes though not so abruptly depressed.

REMARKS AND COMPARISONS. The genus Ptychopleura Kobayashi 1936 was changed by its author the same year to Ptychopleurites, Kobayashi having found the former name preempted.[1] As stated by Frederickson (1942 MS., p. 70) Ptychopleurites amplooculata differs from P. brevifrons Kobayashi (genotype) in having narrower posterolateral limbs and larger, more posteriorly located palpebral lobes. The pygidium described above agrees in size with an associated cranidium of the species, and is referred to P. amplooculata mainly because of this physical proximity.

OCCURRENCE. Restricted to the Irvingella subzone, 1 to 3.5 feet below the top of the Cameraspis zone in both the Wilberns limestone of Texas and the Honey Creek limestone of Oklahoma. It is moderately abundant in the Wilberns limestone and is associated with species of Irvingella and Acrocephalites. Stations 4w.11, Packsaddle Mountain, 7w.12, White Ranch Road; 8w.5, Marble Falls-Burnet Highway; 9w.14, Baldy Mountain; 10w.8 Smoothingiron Mountain; 12.13 and 12w.14, Threadgill Creek.

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[1]Kobayashi 1936, Jour. Geol. Soc. Japan, vol. 43, p. 922, note no. 2.

HYPTOYPES LPT-58a (pygidium) and LPT-58b (cranidium), Sta. 12w.14, Threadgill Creek; LPT-59, Sta. 8w.5, Marble Falls-Burnet Highway; LPT-60, Sta. 4w.11, Packsaddle Mountain.

Order PROPARIA?

Family UNDETERMINED

Genus XENOCHEILOS Wilson, n. gen.

Cranidium small, highly convex, quadrate in shape if the genal spine is excluded. Glabella long and sunken, parallel-sided, sharply crested, highest at occipital ring; three pairs of oblique glabellar furrows present; occipital furrow faint at center, distinct at sides; occipital ring parallel-sided. Definite rim and marginal furrow absent; brim wide, and from an anterior concave portion rises steeply to near the circumglabellar furrow; fixed cheeks as wide as glabella, strongly elevated laterally; palpebral lobes unknown; posterolateral limbs greatly depressed, traversed by a wide deep furrow, and extended into a short genal spine that curves outward and backward.

Facial suture proceeds posteriorly without indentation from anterolateral corners of cranidium to a point lateral to outer end of ocular ridge, course around palpebral lobes unknown, proceeds posterolaterally and appears to cut the margin of the cephalon anterior to the genal spine; proparian?

GENOTYPE. Xenocheilos minutum Wilson, n. sp.

COMPARISONS. Xenocheilos resembles Pterocephalia Roemer in its wide fixed cheeks, sharply crested and sunken glabella, and oblique, well defined glabellar furrows. It is, however, only one-sixth the size of Pterocephalia and differs from it in all respects other than those mentioned. Superficially the genus resembles Holcacephalus Resser in its steeply sloping brim, wide fixed cheeks, prominent ocular ridges, and proparian facial suture. The two specimens collected were compared with specimens of Holcacephalus appalachius (Resser) from the Cedaria zone of the Missouri Bonneterre limestone, and with a pleisiotype of Holcacephalus tenera (Walcott) from the Cedaria zone of the Cap Mountain limestone of Texas, the specimens being furnished by Dr. Christina Lochman of Mount Holyoke College. Xenocheilos minutum differs from all known species of Holcacephalus in its lack of an occipital spine and definite anterior rim and marginal furrow, and in its possession of a sunken, much more strongly furrowed glabella. Xenocheilos is apparently somewhat larger than Holcacephalus.

Xenocheilos minutum Wilson, n. sp.
Plate 3, figures 21-23

Cranidium small, being about 4 by 5 mm. in size, slightly wider than long, highly convex, quadrate in shape excluding genal spines. Glabella long and sunken, parallel-sided, evenly rounded and sloping gently downward anteriorly,

convex and sharply crested in transverse profile; circumglabellar furrow wide and deep; anterior pair of glabellar furrows barely visible, two posterior pairs distinct, short and slightly oblique; occipital furrow much deeper at sides than at center; occipital ring straight and parallel-sided. Definite rim and marginal furrow absent, the anterior border of the cranidium being a slightly concave extension of the wide brim which rises steeply at a 45° angle to the preglabellar area, and then slopes down to the circumglabellar furrow; fixed cheeks as wide as glabella, rise gradually from the circumglabellar furrow, their lateral edges being almost as elevated as the dorsal surface of the glabella; palpebral lobes unknown; ocular ridges wide and very distinct, slightly oblique, originating lateral to anterior pair of glabellar furrows; posterolateral limbs narrow, greatly depressed, traversed by a wide deep furrow that widens laterally, and extended into a short genal spine that curves outward and gently backward.

Facial suture proceeds posteriorly without indentation from anterolateral corners of cranidium to a point lateral to outer end of ocular ridge, course around palpebral lobes unknown, proceeds posterolaterally and appears to cut the margin of the cephalon anterior to the genal spine; proparian?

OCCURRENCE. Rare in the Cameraspis zone. Two specimens found at different localities, each about 30 feet

above the base of the Wilberns limestone. Stations 9w.9, Baldy Mountain and 12w.2, Threadgill Creek.

HOLOTYPE LPT-62, Sta. 12w.2, Threadgill Creek; paratype LPT-61, Sta. 9w.9, Baldy Mountain.

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EXPLANATIONS OF PLATES

All figured specimens are preserved in the collections of the Department of Geology, The University of Texas, Austin, Texas. In recording the stations from which the specimens were collected, the "42-" of the complete station designation has been omitted.

PLATE I

PLATE I (continued)

PLATE I

PLATE 2

PLATE 2 (continued)

PLATE II


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PLATE 3

PLATE III

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